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AQUATIC HABITATS AND BIOTA

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Aquatic habitats are important for several reasons: (1) for native species, many of which are protected as threatened or endangered, (2) for game fish, which supply recreational fishing, (3) as water sources for terrestrial wildlife, and (4) as stopover points for migratory waterfowl. The Nevada/Utah study area is characterized by a high degree of endemism (i.e., restriction to a small geographic area such as a spring) in its native aquatic species, many of which are protected by federal or state laws and require impact assessments and mitigation appropriate to Section 7 of the Endangered

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1.0 INTRODUCTION

Aquatic habitats are important for several reasons: (1) for native species, many of which are protected as threatened or endangered, (2) for game fish, which supply recreational fishing, (3) as water sources for terrestrial wildlife, and (4) as stopover points for migratory waterfowl. The Nevada/Utah study area is characterized by a high degree of endemism (i.e., restriction to a small geographic area such as a spring) in its native aquatic species, many of which are protected by federal or state laws and require impact assessments and mitigation appropriate to Section 7 of the Endangered Species Act or similar legislation. In addition, a number of native species not currently protected by law have been recommended for such protection by local experts. The Texas/New Mexico study area has a less diverse native aquatic fauna, but does have some endemism.

Both native and introduced species provide fishing opportunities, a major recreational activity for many resident and nonresident sportsmen. A wide cross-section of population, including children, the elderly, lower income families, and the traditional sportsman, enjoy fishing.

Aquatic habitats provide water for terrestrial wildlife, particularly birds and the larger mammals, and for this reason they are some of the most important habitats in the area, without which colonization of the surrounding vicinity could not take place. Many surface water habitats in the project area provide stopover points for migratory waterfowl and their absence would alter seasonal flight patterns and cuase crowding and possible mortality at remaining wetlands and water holes.

Springs, streams, and impoundments also provide swimming, camping, and picnicking areas. Bird and wildlife observation in the study area is commonly best near aquatic habitats. Since surface waters are already scarce throughout the study area, their utilization not ony by fish and wildlife, but also by sportsmen and other visitors indicates their importance as a resource. The arid land of the study area depends upon its few water sources in order to maintain the fragile equilibrium of its food web and its value as a unique recreational resource.

2.0 AQUATIC HABITATS AND BIOTA

2.1 NEVADA/UTAH

Aquatic Habitats

Most of the Nevada/Utah study area is within the Great Basin, except for the pluvial White River system which is a part of the Colorado River drainage. The Great Basin is characterized by internal drainage with few rivers, the largest being the Humboldt, which is north of the study area. The large natural lakes (Tahoe, Pyramid, Walker, Great Salt, and Utah lakes) of the Great Basin are all outside the study area. Perennial cold water streams occur in most of the mountain ranges, and isolated springs which remain after desiccation of Pleistocene lakes in the Great and Bonneville Basins are found in lowland areas. The pluvial White River system, located in the south-central portion of the study area is biologically similar to the Great Basin. Aquatic habitats are limited to springs and a few perennial streams, primarily in the mountains. Most if not all of the natural waters in the study area have been altered by human activities related to agriculture, grazing, and urbanization. In addition, impoundments of various sizes have been constructed throughout the area.

A variety of native aquatic organisms at all trophic levels inhabit these springs, lakes, and streams, and many endemic forms have evolved as a result of isolation. In addition, numerous exotic species have been introduced by man. These introductions, along with habitat modifications, have often been detrimental to the native species. For example, the endemic Lahontan and Utah cutthroat trout have maintained pure strains in only a few isolated mountain streams since stocking of rainbow trout in their habitat has often resulted in hybridization. Overfishing and habitat degradation have also reduced native trout population.

The three major types of permanent aquatic habitats considered here are point (springs and seeps), linear (creeks and rivers), and large area (ponds, reservoirs, and lakes) habitats. Although a significant number of large area habitats are scattered throughout the siting area, this type is generally not as important a contributor of aquatic habitat as the other two types in the siting area. In addition, various ephemeral wetlands and floodplains support aquatic resources during portions of wet years.

Wetlands: The term "wetlands" means those areas that are inundated by surface or groundwater with a frequency sufficient to support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs and similar areas such as sloughs, potholes, wet meadows, river overflows, mud flats, and natural ponds.

Wetlands have particular importance because they are protected by Executive Orders 11988 and 11990, which were issued by the President as part of a comprehensive environmental message of 24 May 1977. The orders link the need to protect lives and property with the need to restore and preserve natural and beneficial wetland values.

The purpose of Executive Order 11990 is "to avoid to the extent possible the long and short-term adverse impacts associated with the destruction, modification or occupancy of wetlands and to avoid direct support of new construction in wetlands wherever there is a practicable alternative" (Executive Order 11990).

Besides executive order protection, wetlands of the Nevada/Utah area are often recognized, managed, and/or protected as part of National Wildlife Refuges and Ranges, Unique and Nationally Significant Wildlife Ecosystems (U.S. Fish and Wildlife Service); Research Natural Areas (Federal Committee on RNA); National Parks, Monuments, and Recreation Areas (National Park Service); State Wildlife Management Areas (Nevada Department of Wildlife and Utah Division of Wildlife Resources); and State Parks, Recreation Areas and Reserves (Nevada and Utah State Parks Divisions).

The National Wetland Inventory of the U.S. Fish and Wildlife Service reports that wetlands mapping in Nevada and Utah has not been started, so there is no official delineation of wetlands for the project. Figure 3.2.2.7-1, Chapter 3 in the DEIS, however, shows major wetlands and aquatic habitats in the M-X study area. All perennial streams, major rivers and some washes are mapped in this figure. It is unlikely that much of the M-X system would be sited in wetlands since these are generally geotechnically unsuitable for construction.

Most of the wetlands in the Nevada/Utah study area are formed by springs, since few permanent rivers fed by runoff are present (e.g., the Humboldt River and its tributary, the Reese River). Several types of wetlands are formed at these springs or along permanent or intermittent rivers and streams depending upon site-specific physical characteristics. Wetlands may also be associated with lakes, but even though many valleys in the study area are closed basins with internal drainage, few contain permanent lakes. An exception is in Ruby Valley, where Ruby Lake is supported by drainage from the east side of the Ruby Mountains (Cronquist et al., 1972, p. 92).

A discussion of the vegetation communities found on wetlands and floodplains is in the separate Technical Report on Vegetation (ETR-14); information about use of wetland areas for wildlife and its value as habitat are in the separate Technical Report on Wildlife (ETR-15). Specific references are made to value as wildlife habitat in the discussion of selected key wetlands that follows.

Ruby Marsh, also called Ruby Lake, is within Ruby Marsh National Wildlife Refuge in southwestern Elko County and northwestern White Pine County. It covers 20,000 acres and is fed by about 135 springs at a rate of 10 to 15 thousand acre-ft per year. Another 100,000 acre-ft are contributed annually by precipitation and runoff. No permanent streams flow into the lake, and there is no outlet. The water, however, is quite fresh for a Great Basin lake (Grater, 1971). Five mi north, over a low divide, is Franklin Lake, which covers 20,000 acres. In wet years it resembles Ruby Marsh; however, it is basically a wet meadow. Most of Franklin Lake is privately owned and intensively used for irrigation, mowing hay, and grazing livestock. Thus, it lacks the natural quality preserved at Ruby Marsh National Wildlife Refuge.

Pahranagat Valley, in Lincoln County, contains a wetland area in the bed of the pluvial White River, which has many springs with riparian and marsh vegetation. The three springs considered most valuable by the Inventory of Natural Landmarks of the Great Basin (Bostick, et al., 1975) are Ash, Crystal, and Hiko. They are all

LEGEND

MAJOR WETLANDS AND RIPARIAN HABITAT

	WATER BODY
	WATER COURSE WITH FLOW DIRECTION INDICATED
	INTERMITTENT WATER COURSE
	INTERMITTENT WATER BODY
	MARSH
	SPRING
WMA	WILDLIFE MANAGEMENT AREA

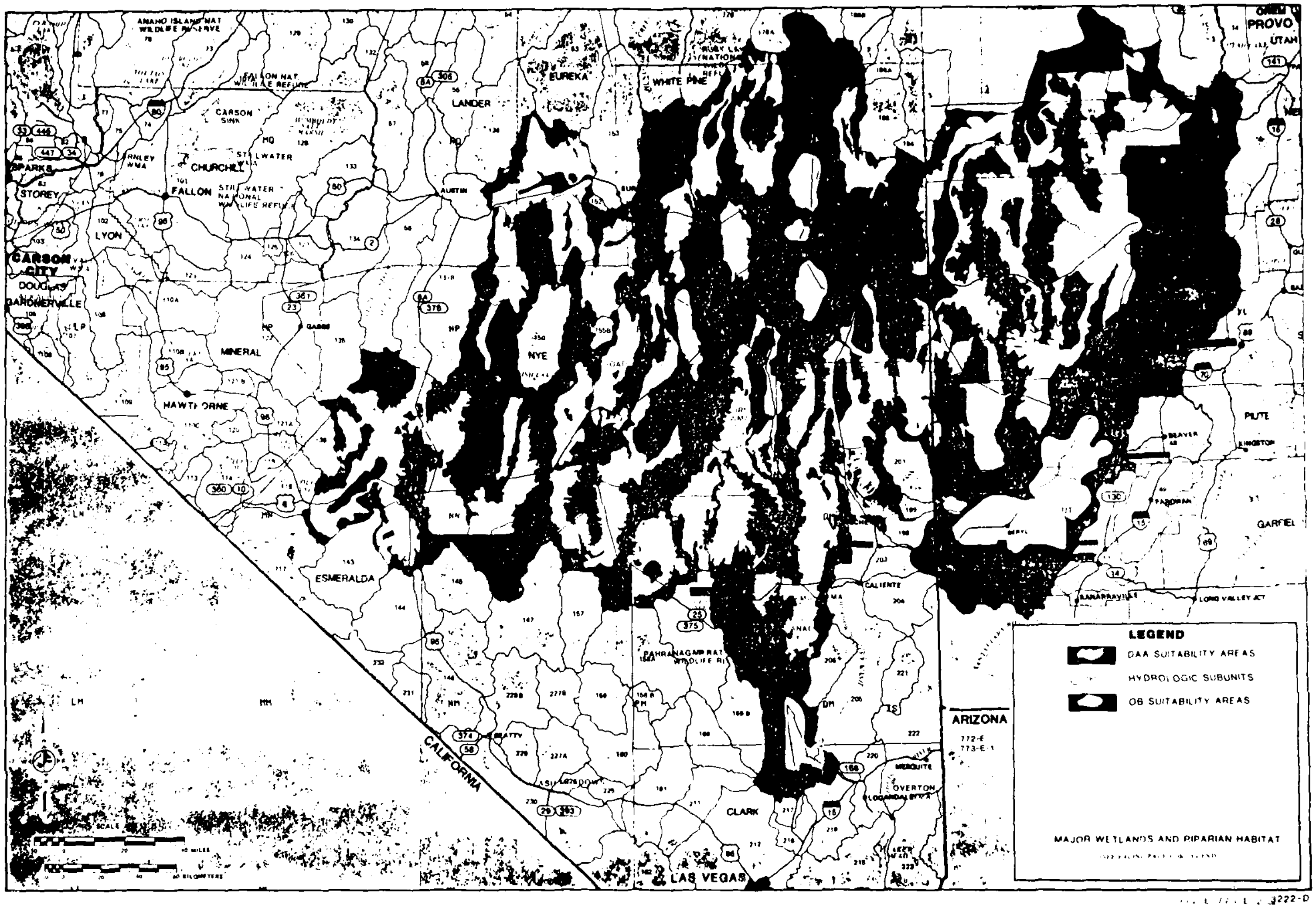

Figure 2.1-1. Major wetlands and aquatic habitats in Nevada and Utah.

large, thermal springs, varying in temperatures from 80° to 97° F. Nevada Department of Wildlife has designated these three springs as fish sanctuaries, and several species or subspecies of threatened or endangered fish live in Ash and Crystal Springs (Pahranagat roundtail chub, White River speckled dace, and White River springfish). Ash Springs is also the type locality for several endemic aquatic insects (Bostick, et al., 1975). Hiko Spring is in need of rehabilitation to reestablish native fish that were eliminated by the introduction of an exotic fish species.

In White River Valley, more than 37,000 acres of high quality waterfowl habitat are managed by federal and state agencies. Much of the management area consists of reservoir, marsh, and native meadow habitat. The major reservoirs and marsh areas include Adams-McGill, Dacey, Haymeadow, Tule and Old Place reservoirs and the Dacey Slough (Barngrover, 1974). Meadow vegetation, which is maintained for waterfowl habitat, includes alkali bulrush, rush, Carex, and saltgrass-black greasewood. The springs and streams feeding the reservoirs contain one, and possibly two, species of rare fish endemic to the White River: the Mormon White River springfish and possibly the White River desert sucker (at Sunnyside). Their distribution and status are discussed in the separate Technical Report on Protected Species (ETR-17).

Fish Springs National Wildlife Refuge, in Utah, is located at the southern edge of the Great Salt Lake Desert and is partially surrounded by rolling dunes. Three major springs and many smaller springs have a combined flow of 45 to 50 ft^3/second (Bolen, 1964). This strong flow has inundated an area 6 mi long and 3 mi wide which is being expanded by construction of dikes and ditches to improve the habitat for waterfowl. The various plant communities of this spring-fed salt marsh form concentric zones varying in wetness and salinity. At the outer border are Distichlis communities, which extend to the edge of the sand dunes. Juncus meadows and borders separate the Distichlis complex from the permanently wet zone occupied by Phragmites and Eleocharis. Scirpus and Typha emergents border the submerged communities of Chara and Ruppia (Bolen, 1964).

The abundant waters at Fish Springs have a long history of use. The Goshute Indians intensively used these springs before European man began using them as an important way-station for explorations and later for the Pony Express. In addition, numerous but short-lived attempts were made at ranching and farming the area (Bolen, 1964). The area is presently managed by the U.S. Fish and Wildlife Service for waterfowl habitat and is primarily used for hunting waterfowl.

River Systems: The Humboldt River flows east to west from the Independence Mountains to the Humboldt Sink and is the major drainage system in the northern half of the project study area. It is the only river system wholly within the Great Basin. The Reese River flows north from the ToiYabe Mountains, meeting the Humboldt River near Battle Mountain. The Humboldt River has an average annual discharge of about 500,000 acre-ft per year, most of which is used for irrigation (Cronquist et al., 1972).

The earliest route across the Great Basin followed the course of the Humboldt. Travel along it was particularly heavy during the gold rush in 1849 and 1850 (Bower, 1964). Bottomlands along the Humboldt River were probably the first lands in the Great Basin to be overgrazed (Frink, 1850). Much of the floodplain along the lower part of the river is now intensively managed according to approved conservation practices. These bottomlands are valuable to ranching operations in the area and are far from neglected or abused. They have been converted, however, from wild floodplain to hay fields and improved pastures.

The river course from Winnemucca to Humboldt Lake (sink) is entrenched from 10 to 20 ft. In a field visit to this area, Bostick, et al. (1975) found no floodplain vegetation and saw no wildlife or wildlife habitat. They describe the Rye Patch Recreation Area as "an irrigation reservoir with the usual drawdown. The residual pool is shallow and wind keeps it muddy. It is not exactly a thing of beauty, and it can't be much of a fishery either" (Bostick, et al., 1975). However, Goodwin and Niering (1975) report that a particularly interesting riparian site extending south from Rye Patch to Lovelock has considerable wildlife, and they recommend this area as suitable for registry as a natural landmark by the National Park Service. (Note the natural landmark registry program is now conducted under the auspices of the Heritage Conservation and Recreation Service (USDOI)).

The Virgin River, which is the other major river in the project area, which flows southwest through Zion National Park in Utah and becomes part of Lake Mead near Overton, Nevada. The floodplain and flooding characteristics of the lower part of the river are largely controlled by Lake Mead water level. The Virgin River is particularly important as aquatic habitat for several rare and endangered species of fish, such as the woundfin and Virgin River roundtail chub.

Meadow Valley Wash is a small perennial stream that flows south, joining the Muddy River at Moapa, Nevada. There is well-developed riparian vegetation along its banks in several areas which supports many wildlife species, such as beaver. Native fish inhabiting this stream are speckled dace and desert sucker.

The White River is actually composed of disjunct water bodies supplied by perennial springs whose groundwater source is the carbonate rock formations of Long, Jakes, Dry Lake, Delamar, Garden, Coal, White River, Pahranagat, and Muddy River Valleys. In White River Valley, surface water occurs from the headwaters in the White Pine Range to the White Pine-Nye County border and from Sunnyside Creek through Adams-McGill Reservoir. In Pahranagat Valley it flows from Crystal Spring to Alamo. Spring Valley, also part of the pluvial White River, has several artificial ponds made by the BLM at Shoshone Natural Area. At least one of these ponds is currently used as a refugium for the endangered Pahrump killifish. In both these valleys, extensive wetland areas (discussed above) are managed for wildlife.

The Sevier River system originates in the Dixie National Forest in southwestern Utah and flows north; northeast of Leamington it turns west, bends around the Canyon Mountains and heads south, ending at Sevier Lake. This lake is intermittent (a playa), because of water use for agriculture and the many reservoirs created along the river.

In the arid valleys that are suitable for M-X deployment in Nevada and Utah, aquatic habitats are limited in size and abundance. Lake Mead and Utah Lake are the only large area habitats which occur relatively close to potential siting areas. Small to moderate sized lakes (e.g., Adams-McGill Reservoir and Upper and Lower Pahranagat Lake) occur relatively infrequently throughout the study area. The Colorado River, at its nearest point to the project area, has been dammed to form Lake Mead. The Muddy River, as with the White River, is actually a disjunct water body supplied by perennial springs. Streams occur primarily in mountain canyons throughout the area, providing cold water habitat for game fish such as trout.

Spring habitats vary greatly with respect to water quality, configuration, flow rate, and accompanying aquatic and riparian vegetation. It is correct to characterize most habitats as unique, although some may be classified into basic categories. Most commonly, springs are classified as hot, cold, or fluctuating (usually according to season). Alkalinity, hardness, and dissolved solids usually vary greatly with spring source, although both turbidity and dissolved oxygen are usually low. Some spring water has been radiocarbon dated at more than 1,000 years old (since it entered the soil via precipitation). Flow can vary from a trickle to several 100 cfs, but not usually in the same spring. This defines the extent of the spring habitat. Some consist of a large spring source pool, while others have essentially no open water and a variable amount of marshy area. Most springs, however, have been altered to some extent, primarily by impoundment or diversion, for agricultural or recreational purposes. Many of these unique springs have provided an isolated habitat conducive to speciation of ancestral fish, originating from the drying Pleistocene lakes 10,000 to 20,000 years ago. They also provide a water source for wildlife.

Stream Resource Evaluation: Stream habitats have been evaluated, ranked, and mapped by each state. These studies were undertaken to assist many governmental agencies in the assessment of proposed developments in light of the existing fisheries resources. Similar products have been produced throughout the arid West with the cooperation of the Department of Interior, Environmental Protection Agency and the state fish and wildlife departments. Funding of these evaluations was provided by the Environmental Protection Agency, Federal Interagency Energy/Environment Research and Development Program and Office of Energy, Minerals and Industry. The stream classification system used by each state is as follows:

The Nevada Department of Wildlife has evaluated permanent streams and their tributaries and streams protected by or proposed for protection under the Wild and Scenic Rivers Act for fish habitat. Intermittent streams which are required for the maintenance of a highly valued fishery were also evaluated. Value class of each stream was designated on the following criteria: (1) occurrence of state or federal listed endangered species, (2) occurrence of state or federal listed threatened species, (3) occurrence of species of high interest to the state and (4) possibility of habitat restoration, reclamation or mitigation. Each criterion was further divided into four value classes which describe the fish habitats present. The final value classification assigned to the habitat was the highest rating given the Criteria 1 through 3. Criterion 4 was used in only a few streams to either upgrade or downgrade the overall habitat value when the overall rating was lower than value class I.

Value class was determined for each criterion as follows (from Nevada Department of Wildlife, 1977):

Criterion 1: Status of State or Federal Endangered Species

Value Class I	Documented occurrence (legally defined) of any state or federally chartered endangered species.

Value Class II	Probable occurrence or past occurrence of an endangered species based on professional judgement of personnel familiar with the stream reach. It is differentiated from Value Class I by the fact that undocumented reports of the occurrence of an endangered species may be available for the reach.
Value Class III	Not applicable - only value classes I, II, and IV were used for Criterion 1.
Value Class IV	Absence or no record of any endangered species.

Criterion 2: Status of State or Federal Threatened Species

Value Class I	Documented present occurrence of a state or federally chartered threatened species.
Value Class II	Documented past occurrence and probable continued existence of a threatened species.
Value Class III	Possible occurrence of a threatened species (undocumented) including potential restocking of threatened species.
Value Class IV	Absence or no record of any threatened species.

Criterion 3: Species of High Interest

Value Class I	Habitat maintaining outstanding populations of species of high interest as defined by the State. Includes self-sustaining "wild" populations that maintain a high yield, or represent a unique esthetic, scientific, economic, educational, or recreational value.
Value Class II	Habitat that is intensively used in terms of the several requirements of a highly-valued population or required habitat for less highly-valued populations of a species of high interest.
Value Class III	Habitat that is occasionally used by a highly-valued population of high interest or an essential habitat for maintaining a relatively low valued population of a species of high interest.

	Occasionally-used habitat implies that reduction of that habitat would not seriously impair the continued existence of the population.
Value Class IV	Habitat that is not used or is sporadically or unpredictably used by species of high interest.

Criterion 4: Habitat Restoration, Reclamation, or Mitigation Potential

Value Class I	Current technology makes it probable that the area to be restored or reclaimed to at least an equally valued fishery as that existing prior to development. Acceptable compensation options are likely.
Value Class II	Moderate potential exists for either restoration of the habitat or reclamation to an equal-or-higher-valued fishery, or total compensation options can be defined.
Value Class III	Low potential for restoration to present species composition and population levels; however, partial compensation options can be defined.
Value Class IV	Very low or essentially no potential for restoration or reclamation of the habitat to its present species composition and population levels; no alternate resource could be introduced that would be as highly valued; no acceptable options are available to compensate for the loss of this habitat at the present time (includes stream reaches that have been designated as habitat for reintroduction of an endangered species by a National Recovery Team or State Rehabilitation Plan).

The live streams of Utah are ranked using two primary criteria: (1) the occurrence of endangered species and the importance of species of high interest (game fish); and (2) the potential for stream restoration, reclamation or mitigation. For endangered species, the values of critical (for documented occurrence of a species officially listed as endangered on the federal list) or high priority (for locations of probable occurrence) were assigned to streams. For species of high interest, habitat values were defined as critical (necessary for high priority (areas of high species use), substantial (species exists in area but loss of habitat would not impair total species productivity), limited (species may be absent or only found occasionally), and no value (lists reaches of stream containing no fish of recreational or professional interest). Habitat numerical values were assigned to criterion number 2 after a review of the population and reproductive status of the species and the watershed and stream quality of the habitat. Numerical values were also assigned to each of the other criteria. Overall stream rating was calculated using the sum of these criterion values as shown in Table 2.1-1.

Table 2.1-2 presents information derived from each state's Stream Resource Evaluation in conjunction with other agency information, on creeks and rivers throughout the proposed deployment area by hydrologic subunit. These subunits and streams are shown in Figure 2.1-1.

Aquatic Biota

The aquatic habitats in Nevada and Utah are populated by a myriad of native and introduced life forms at all trophic levels. Hydrologic subunits with aquatic habitats that support fish are shown in Figure 2.1-2. As Pleistocene lakes of the Great Basin dried, aquatic organisms became isolated, and the resulting disjunct populations have evolved divergently to form distinct types. This evolution is continuing, and a number of subspecies are recognized today. The nature of the pluvial lake system and its desiccation has resulted in a limited distribution of these organisms and habitats. Environmental conditions in these habitats are often rigorous and may have, in addition, little variability (e.g., constant temperature). The biological communities that have evolved in such habitats are consequently susceptible to impact from outside influences since they generally lack the ability to tolerate change in their environment or community structure. Thus, introductions of non-native species frequently reduce the amount of habitat available to native species through competition and predation, since the introduced species are usually biological generalists that easily adapt to the native conditions.

Aquatic habitats and their resident biota in the Nevada/Utah siting area have not been adequately examined to describe organism abundance, population dynamics, or habitat requirements. Intensive studies at five spring habitats, four in Nevada and one in Utah, have been conducted at monthly intervals from June through September 1980 for this project. The results will be included in the FEIS. These and other studies may result in the identification of several new taxa, particularly for invertebrates. Many of these organisms may need to be nominated for some type of protected status as their distribution and abundance become known. Protected aquatic species are discussed in the Technical Report on Protected Species.

Fish: Although the Nevada/Utah siting area is generally arid, the limited surface waters contain a variety of fish species. Table 2.1-3 shows that approximately 100 species have been recorded for the study area, and most of these could be affected either directly or indirectly by M-X siting in this area. About half of the fish listed are native to the area, and the majority of these native species have a status of endangered, threatened, or of special concern on state or federal lists. The native trout and suckers generally inhabit streams, rivers, or lakes while the native minnows and killifish are most often found in springs or their outflows. The other species have been introduced into many habitats, particularly those near towns or ranches.

Table 2.1-1. Ranking system for overall stream rating in Utah.

CLASS	OVERALL RATING	DESCRIPTION
1	31-35	Critical (Excellent)
2	25-30	Critical (Excellent)
3	18-24	High Priority (Good)
4	11-17	Substantial (Fair)
5	7-10	Limited (Poor)

780-1

Source: Wydoski and Berry, 1976.

Table 2.1-2. Stream classification and distribution of fish by hydrologic subunit in the Nevada/Utah study area (Page 1 of 5).

HYDRAULIC SUBUNIT STREAM	LENGTH (mi)	VALUE CLASS	DOMINANT SPECIES	STOCKED	MONTHLY STREAM FLOW (cfs) AVE.	MIN.	MAX.	TEMPERATURE
SNAKE VALLEY (#4)								
Baker Creek	9	3-I	Brook, Rainbow, Utah Cutthroat Trout	Annually	8.53	1.87	19.6	
Deep Canyon Creek	4	2-I	Utah Cutthroat Trout	None				
Hampton Creek	7.5	2-I	Utah Cutthroat Trout	None				
Hendries Creek	11	2-I	Utah Cutthroat Trout	None				
Lehman Creek	11	3-I	Brown, Rainbow, Utah Cutthroat Trout	Annually	7.49	3.67	19.6	
Silver Creek	21	3-I	Brown, Rainbow, Utah Cutthroat Trout	None				
Smith Creek	12	3-II	Rainbow Trout	None				
Snake Creek	18.5	3-I	Rainbow Trout	Annually				
Spring Creek	0.8	3-II	Rainbow Trout	None				
Strawberry Creek	7	3-II	Brook, Rainbow, Utah Cutthroat Trout	Not				
Birch Creek	4	3	Rainbow, Snake Valley Cutthroat Trout	Not				
Burnt Cedar Creek	5	3	Rainbow, Cutthroat Trout	Not				
Granite Creek	4	3	Rainbow Trout	Rainbow				
Thomas Creek	7	3	Rainbow Trout	Rainbow				
Trout Creek	0.7	3	Rainbow, Snake Valley Cutthroat Trout	Not	4.34	1.75	6.25	
SEVIER DESERT VALLEY (#46)								
Sevier River, in part	48	5	None	None				
Sevier River, in part	12	4	Yellow Perch, largemouth Bass, Sun Fish, Walleye, White Bass, Crappie		129,000 ac-ft/yr			
Oak Creek	8.5	3		Rainbow	4,000 ac-ft/yr			
Pioneer Creek				Rainbow	2,000 ac-ft/yr			
Chalk Creek	3.5	3/4		Rainbow	21,570 ac-ft/yr			
Meadow Creek	3.5	3		Rainbow	4,200 ac-ft/yr			
Corn Creek	9.0	3		Rainbow, Brown	6,700 ac-ft/yr			
Pine Creek				None	800 ac-ft/yr			
Wild Goose Creek				None	800 ac-ft/yr			
Maple Hollow Creek				None	1,500 ac-ft/yr			
Whiskey Creek				None	800 ac-ft/yr			
HUNTINGTON VALLEY (#47)								
Box Canyon Creek	7.0	2-I	Brook, Lahontan Cutthroat Trout					
Brown Creek	6.0	3-II	Brook Trout					
Carville Creek	5.5	2-I	Lahontan Cutthroat Trout					
Cave Creek	0.3	3-II	Brook Trout					
Corral Creek	38	3-I, 3-II	Brook Trout		1.32		2.5	46-59°F
Cottonwood Creek	7	3-II	Rainbow Trout					
Echo Canyon Creek	4.5	2-I	Lahontan Cutthroat Trout					
North Furlong Creek	6.3	2-I, 3-I	Brook, Lahontan Cutthroat Trout					
Gennette Creek	5.0	2-I, 3-II	Brook, Lahontan Cutthroat Trout					
Gilbert Creek	8.0	2-I, 3-II	Brook, Lahontan Cutthroat Trout					
Green Mountain Creek	11.0	2-I, 3-II	Brook, Lahontan Cutthroat Trout					
Humboldt River, South Fork	28	2-II, 3-I	Brook, Lahontan Cutthroat, Rainbow Trout	Cutthroat Trout	1.36 fps/3-27.3 cfs			50-67°F
Kleckner Creek	9	2-I, 3-I	Brook, Lahontan Cutthroat Trout					
Lindsay Creek	11	3-III	Rainbow Trout					
Little Humboldt River, South Fork	25	2-I	Brook, Lahontan Cutthroat Trout					
Mahogany Creek	2.5	2-I	Lahontan Cutthroat Trout					
McCutcheon Creek	8.5	2-II, 3-II	Brook, Lahontan Cutthroat Trout		1.6 fps/8.1 cfs			64°F
Mitchell Creek	10.0	2-I	Lahontan Cutthroat Trout	Cutthroat Trout				
Pearl Creek	11.5	2-II, 3-I	Brook, Lahontan Cutthroat Trout					
Rattlesnake Creek	10.5	2-I, 3-I	Brook, Lahontan Cutthroat Trout					
Segunda Creek	3.5	2-I	Lahontan Cutthroat Trout					
Seitz Creek	18	3-I	Brook Trout					
Smith Creek	22	2-I, 3-I	Brook, Lahontan Cutthroat Trout		1.9 fps/6.1 cfs			58°F
Ten Mile Creek	18	3-III	Brook Trout					
Toyn Creek	7	3-II	Brook, Rainbow, Lahontan Cutthroat Trout					
Willow Creek	12	3-II	Brook Trout		1.2 fps/1.77 cfs			

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Table 2.1-2. Stream classification and distribution of fish by hydrologic subunit in the Nevada/Utah study area (Page 2 of 5).

[illegible] STREAM	LENGTH (mi)	VALUE CLASS	DOMINANT SPECIES	STOCKED	MONTHLY STREAM FLOW (cfs) AVE.	MIN.	MAX.	TEMPERATURE
PINE VALLEY (#53)								
Humboldt River	42	3-II	Channel Catfish, Black Bullhead, Largemouth Bass, Smallmouth Bass, Bluegill Sunfish					
CLOVER LAKE VALLEY (#55)								
Hall Creek	7.5	3-IV	Rainbow Trout	Rainbow				
Iowa Canyon Creek	8.5	2-III	Lahontan Cutthroat Trout	Rainbow				
UPPER REESE RIVER VALLEY (#56)								
Boone Creek	9	3-II	Brook Trout					
Clear Creek	2	III	Brook, Rainbow Trout					
Cottonwood Creek	1.2	III	Brook Trout					
Crane Creek	0.5	II	Lahontan Cutthroat Trout					
Crippen Creek	10	3-II	Rainbow Trout					
Drum Canyon Creek	8	3-I	Brook Trout					
Elder Creek	8		Yellowstone Cutthroat, Rainbow Trout					
Illinois Creek	3.5	III	Brook Trout					
Italian Creek	10	2-II	Lahontan Cutthroat Trout					
Marysville Creek	8	III	Brook, Rainbow Trout					
Mohawk Creek	3.5	IV	Brook, Rainbow, Brown, Lahontan Cutthroat Trout					
Reese River	15	1-II	Brook, Rainbow, Brown Trout					
Silver Creek	4.1	3-III	Brook, Rainbow, Brown, Lahontan Cutthroat Trout					
Stewart Creek	8.5	II	Brook, Rainbow, Brown, Lahontan Cutthroat Trout					
Tierney Creek	8	I	Brook, Lahontan Cutthroat Trout					
Washington Creek	9	2-I	Lahontan Cutthroat Trout					
LOWER REESE RIVER VALLEY (#59)								
Humboldt River	12	III	Channel Catfish, Smallmouth Bass					
Lee's Creek	8	3-I	Brook Trout	Brook Trout				
Mill Creek	18	3-I	Brook, Rainbow Trout	Rainbow				
Trout Creek (a)	10	3-I	Brook Trout	Brook Trout				
Trout Creek (b)	12	3-II	Brook Trout					
SMITH CREEK VALLEY (#134)								
Campbell Creek	8.3	3-III	Brook Trout					
Peterson Creek	6.9	3-IV	Brook, Rainbow Trout					
Smith Creek	9	3-II	Brook, Rainbow, Brown Trout					
BIG SMOKY VALLEY (NORTH) (#137B)								
Big Creek	7	3-II	Brook, Rainbow, Brown Trout	Rainbow				
Birch Creek	10	3-I	Brook, Rainbow, Brown Trout					
Bowman Creek	[illegible].7	3-II	Brook, Rainbow Trout					
Carseley Creek	5	3-II	Brook, Rainbow Trout					
Frenchman Creek	[illegible].3	3-IV	Brook Trout					
Kingston Creek	9.2	3-I	Lahontan Cutthroat, Brook, Rainbow, Brown Trout	Rainbow				
Santa Fe Creek	5.4	2-I	Lahontan Cutthroat Trout					
Sawmill Creek	1	3-II	Brook Trout					
Shoshone Creek	2.5	2-I	Lahontan Cutthroat Trout					
Belcher Creek	3.4	III	Brook, Rainbow Trout					
Broad Creek	3.9	III	Brook, Rainbow Trout	Rainbow				
Jefferson Creek	5	IV	Brook, Rainbow, Brown Trout	Occasionally				
Jett Creek	1.2	III	Brook, Rainbow, Brown Trout	Rainbow				
Last Chance Creek	5.3	II	Rainbow Trout					
Moores Creek	8.9	II	Lahontan Cutthroat, Brook, Rainbow, Brown Trout	Rainbow				
North Town River	7	II	Brown, Rainbow Trout					
Ophir Creek	6.6	II	Lahontan Cutthroat, Brook, Rainbow, Brown Trout	Rainbow				
Pablo Creek	2	IV	Brook, Rainbow, Brown Trout					
Peavine Creek	6.4	II	Yellowstone Cutthroat, Brown, Rainbow, Brook Trout	Rainbow				
South Twin River	7	II	Brook, Rainbow Trout					
Summit Creek	2.3	III	Brook, Rainbow Trout					
Willow Creek	3.3	IV	Brook, Rainbow Trout					
Wisconsin Creek	4.5	III	Brook, Rainbow Trout					

Table 2.1-2. Stream classification and distribution of fish by hydrologic subunit in the Nevada/Utah study area (Page 3 of 5).

HYDRAULIC SUBUNIT STREAM	LENGTH (mi)	VALUE CLASS	DOMINANT SPECIES	STOCKED	MONTHLY STREAM FLOW (cfs)			TEMPERATURE
					AVE.	MIN.	MAX.	
GRASS VALLEY (#138)								
Callahan Creek	3.5	3-II	Brook, Rainbow Trout					
Cowboy Rest Creek	6	3-IV	Rainbow Trout					
Skull Creek	8.1	3-I	Brook, Rainbow, Brown Trout					
Steiner Creek	4.5	3-III	Brook Trout					
KOBEH VALLEY (#139)								
Roberts Creek	8.5	3-I	Brook, Rainbow, Brown Trout					
MONITOR VALLEY								
Coils Creek	4.0		Rainbow Trout					
Denay Creek	3.1		Brook, Rainbow Trout					
Andrews Creek	5.7	II	Lahontan Cutthroat Trout	Cutthroat				
Barley Creek	6	II	Brook, Rainbow, Brown Trout	Rainbow				
Corcoran Creek	3.3	II	Rainbow, Brown Trout					
Cottonwood Creek	7.7	II	Brook, Rainbow, Brown Trout					
Meadow Canyon Creek	?.8	IV	Brook, Rainbow Trout					
Morgan Creek	4.5	IV	No fishes					
Mosquito Creek	6.4	II	Brook, Rainbow Trout	Rainbow				
Pine Creek	6.4	II	Lahontan Cutthroat, Brook, Rainbow, Brown Trout					
Stoneberger Creek	7.1	III	Brook, Rainbow, Brown Trout					
RALSTON VALLEY (#141)								
Hunt's Canyon Creek	2.5	III	Brown, Brook Trout					
STONE CABIN VALLEY								
George's Canyon Creek	1.6	IV	Brook, Lahontan Cutthroat Trout					
LITTLE FISH CREEK VALLEY (#150)								
Clear Creek	4.2	III	Brook, Rainbow Trout					
Danville Creek	2	III	Brook, Rainbow Trout					
Green Monster Creek	2.7	IV	Rainbow Trout	Rainbow				
Sawmill Creek	3	III	Brook Trout					
ANTELOPE VALLEY (#151)								
Allison Creek	4.5		Brook Trout					
NEWARK VALLEY (#154)								
Hunter Creek	5.9		Brook, Rainbow Trout					
Pinto Creek	2	IV	Rainbow Trout					
HOT CREEK VALLEY (#156)								
Hot Creek	1.5	II	Moapa dace, Railroad Valley Springfish, unnamed Tui Chub Subspecies					
Six Mile Creek	3	III	Brook Trout					
GARDEN VALLEY (#172)								
Cherry Creek	2.8	III	Rainbow Trout					
Cottonwood Creek	2	II	Brook Trout					
Pete Hansen Creek	4.4		Brook, Rainbow Trout					
Varini Creek	6.0		Rainbow Trout					
RAILROAD VALLEY NORTH (#173B)								
Duckwater Creek			Unnamed Tui Chub					
Current Creek	16.1	II	Brook, Rainbow Trout					
Deep Creek	0.6	III	Rainbow Trout					
Hooper Canyon Creek	1.8	III	Brook, Rainbow Trout					
Pine Creek	2	III	Brook Trout					
Tory Canyon Creek	5.3	III	Brook Trout					
Willow Creek	0.3	IV	Rainbow Trout					
JAKES VALLEY (#174)								
Illipah Creek	7.4	3-I	Brook, Rainbow, Brown Trout					

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Table 2.1-2. Stream classification and distribution of fish by hydrologic subunit in the Nevada/Utah study area (Page 4 of 5).

[illegible]	LENGTH (mi)	VALUE CLASS	DOMINANT SPECIES	STOCKED	MONTHLY STREAM FLOW (cfs)			TEMPERATURE
					AVE.	MIN.	MAX.	
RUBY VALLEY (#176)								
Battle Creek	5.0	3-II	Brook, Golden Trout					
Carter Creek	3.0	3-II	Brook Trout					
Cave Creek	0.3	3-II	Brook Trout					
Dawley Creek	3.0	3-II	Brook Trout					
Griswold Creek	2.0	3-II	Golden Trout	Golden in 1963				
Lutts Creek	5	3-II	Brook Trout					
Mayhew Creek	3	3-II	Brook Trout					
Myers Creek	3	3-II	Brook Trout					
Overland Creek	6	3-I	Brook Trout					
Robinson Creek	6	3-II	Brook Trout					
Smithers Creek	7	3-I	Golden Trout					
Thompson Creek	4	3-II	Brook Trout					
Thorpe Creek	12	2-I, 3-II	Brook, Lahontan Cutthroat Trout					
Withington Creek	2.5	3-II	Brook Trout					
Wines Creek	3.5	3-II	Brook Trout					
CLOVIS VALLEY (#177)								
Gordon Creek	4.5	3-II	Rainbow Trout					
Greys Creek	3.5	3-II	Brook Trout					
Herder Creek	3.5	3-II	Brook Trout					
Horse Creek	3.5	3-II	Brook Trout					
Johnson Creek	3.5	3-II	Brook Trout					
Leach Creek	4.3	3-II	Brook Trout					
Schoer Creek	5.0	3-I	Brook Trout					
Steele Creek	4.0	3-I	Brook Trout					
Weeks Creek	4.5	3-I	Brook Trout					
BUTTE VALLEY (#178)								
Odgers Creek			Relict Dace					
Spring Creek			Relict Dace					
Paris Creek	3.4	3-II	Brook Trout					
Taylor Creek	6	3-II	Rainbow Trout					
STEPTOE VALLEY (#179)								
Berry Creek	2.0	3-II	Rainbow, Brown Trout					
Lower Berry Creek	2.1	3-II	Rainbow, Brown Trout	Rainbow				
Bird Creek	0.8	3-II	Brook, Rainbow Trout	Rainbow				
Cave Creek	1.9	3-I	Brook, Rainbow, Brown Trout					
Duck Creek	10.5	3-I	Brook, Rainbow, Brown Trout	Rainbow				
East Creek	2.9	3-II	Rainbow Trout					
Egan Creek	2.8	3-III	Rainbow Trout					
Goshute Creek	7.0	2-I	Utah Cutthroat Trout					
Big Indian Creek	6.0	3-II	Brook, Rainbow Trout					
Mattier Creek	4.0	3-II	Brook, Rainbow Trout					
McDermitt Creek	12.0	3-II	Brook, Rainbow Trout					
Nelson Creek	7.0	2-I	Cutthroat Trout					
Steptoe Creek	20.0	3-I	Brook, Brown Trout					
Tailings Creek	7.3	3-II	Brook, Rainbow, Brown Trout	Rainbow				
Timber Creek	1.5	3-II	Brook, Rainbow Trout	Rainbow				
Vipont (Stephens) Creek	4.0	3-II	Brook Trout					
Willow Creek	1.4	3-II	Rainbow, Brown Trout					
SPRING VALLEY (#184)								
Spring Valley Creek			Relict Dace					
Bastian Creek	2.8		Rainbow Trout					
Big Nigger Creek	11	3-II	Brook, Utah Cutthroat, Rainbow, Brown Trout					
Clive Creek	19.4	3-I	Rainbow, Brown Trout					
Eight Mile Creek	3.5	3-IV	Rainbow Trout					
Kalamazoo Creek	6.9	3-I	Brook, Rainbow, Brown Trout					

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Table 2.1-2. Stream classification and distribution of fish by hydrologic subunit in the Nevada/Utah study area (Page 5 of 5).

HYDRAULIC SUBUNIT STREAM	LENGTH (mi)	VALUE CLASS	DOMINANT SPECIES	STOCKED	MONTHLY STREAM FLOW (cfs)			TEMPER-ATURE
					AVE.	MIN.	MAX.	
SPRING VALLEY (#184) (continued)								
McCoy Creek	4.2	3-II	Utah Cutthroat, Rainbow Trout					
Meadow Creek	4.4	3-II	Brook, Utah Cutthroat Trout					
Muncy Creek	6.6	3-II	Brook, Utah Cutthroat, Rainbow Trout					
North Creek	3.3	3-I	Brook, Utah Cutthroat, Rainbow Trout					
Odgers Creek	4.2	3-II	Utah Cutthroat, Rainbow Trout					
Piedmont Creek	6.7	3-I	Brook, Utah Cutthroat, Rainbow, Brown Trout					
Pine Creek	6	2-I	Utah Cutthroat Trout					
Siegel Creek	3.4	3-II	Brook Trout					
Sunkist Creek	1.3	3-II	Brook Trout					
Taft Creek	8.3	3-II	Brook, Rainbow Trout					
Willard Creek	3.5	2-I	Utah Cutthroat Trout					
Williams Creek	3	3-II	Rainbow Trout					
MEADOW VALLEY (#205)								
Meadow Valley Wash	45	IV	Bluehead Sucker, Meadow Valley Speckled Dace					
WHITE RIVER VALLEY (#207)								
Forest Home Creek	2	III	Brown Trout					
Sunnyside Creek	6	II	Rainbow, Brown Trout	Rainbow, Brown				
Water Canyon Creek	10.4	3-II	Rainbow Trout					
White River	19	3-II	Brook, Rainbow, Brown Trout	Rainbow				

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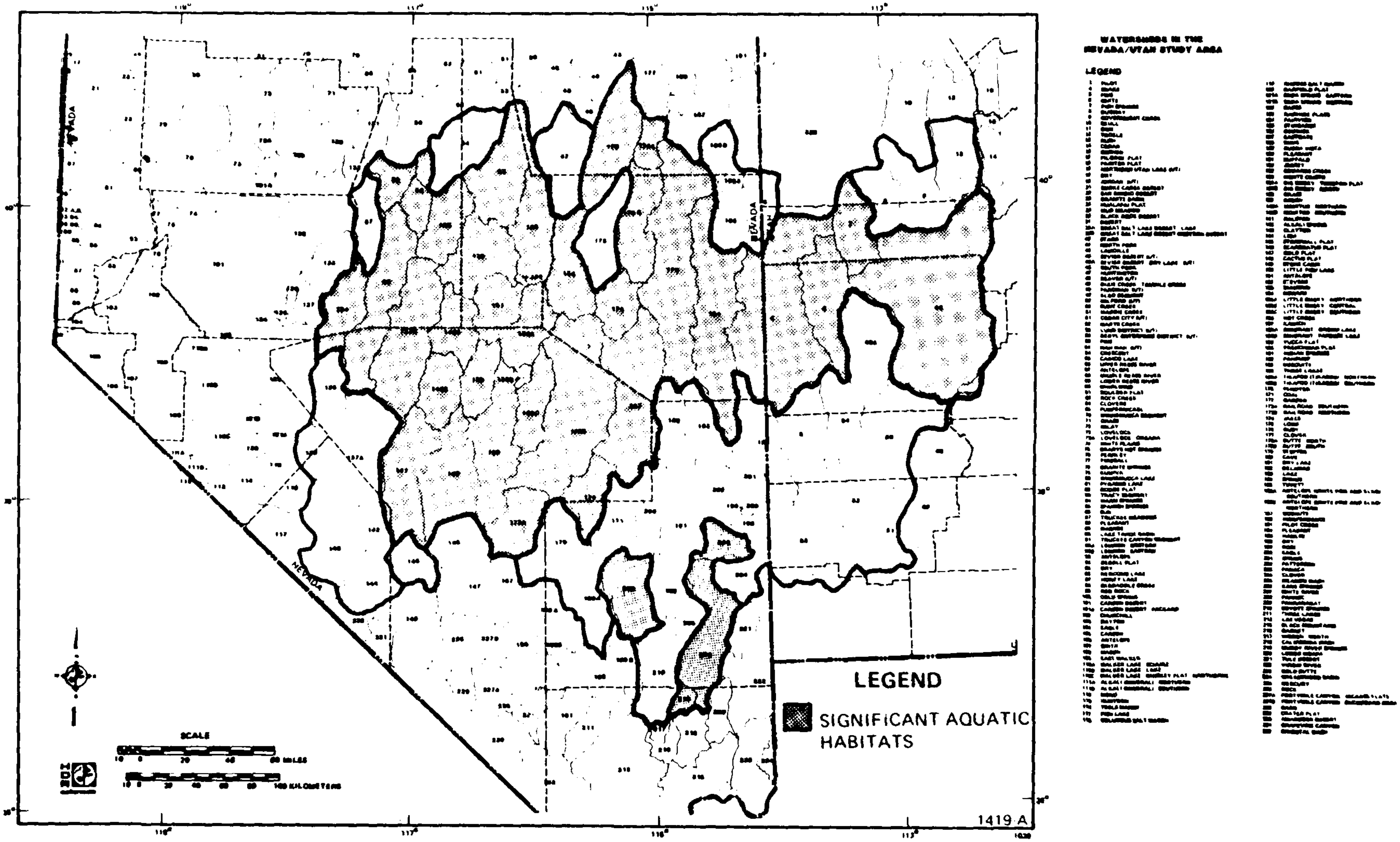

Figure 2.1-2. Hydrologic subunits within the Nevada/Utah study area containing aquatic habitats supporting fish.

Table 2.1-3. Fish of Nevada/Utah study area.

SPECIES NAME	COMMON NAME
Family *CLUPEIDAE*	Shad and Herring
Dorosoma petenense atchafalayae	Mississippi Threadfin Shad
Family *SALMONIDAE*	Salmon, Trout, Grayling, and Whitefish
Oncorhynchus tsawytshcha	King Salmon
O. nerka kennalyi	Kokanee Red Salmon
Salvelinus namayeusn	Lake Trout
S. fontinalis	Brook Trout
S. malma	Dolly Varden Trout
Salmo clarki	Cutthroat Trout
S. c. henshawi	Lahontan Cutthroat Trout
S. c. pleuriticus	Colorado Cutthroat Trout
S. c. Utah	Utah Cutthroat Trout
S. c. lewisi	Yellowstone Cutthroat Trout
S. c. ssp.	Humboldt Cutthroat Trout
S. gaidnveri	Rainbow Trout
S. g. irideus	Southcoast Rainbow Trout
S. g. kamloops	Kamloops Rainbow Trout
S. g. regalis	Tahoe Rainbow Trout
S. g. smaragdus	Pyramid Rainbow Trout
S. aquabonita	Golden Trout
S. trutta	Brown Trout
Thymallus arcticus	Arctic Grayling
Prosopium williamsoni	Mountain Whitefish
P. gemmiferum	Bonneville Cisco
P. spilonotus	Bonneville Whitefish
P. abyssicola	Bear Lake Whitefish
Family *ESOCIDAE*	Pike
Esox lucius	Northern Pike
Family *CATOSTOMIDAE*	Suckers
Pantosteus lahontan	Lahontan Mountainsucker
P. intermedius	White River Mountainsucker
P. platyrhynchus	Bonneville Mountainsucker
P. clarki	Desert Sucker
P. delphinus	Bluehead Sucker
P. virescens	Green Sucker
Catostomus marcocheilus	Biglip Sucker
C. columbianus	Bridgelip Sucker
C. ardens	Utah Sucker
C. latipinnus	Flannelmouth Sucker
C. tahoensis	Tahoe Sucker
Castostomus (Chasmistes) cujus	Cui-ui Lakesucker
C. liouis	June Sucker
Castostomus clarki intermedius	White River Desert Sucker
C. fecundus	Webug Sucker
C. commersoni	White Sucker
Xyrauchen texanus	Razorback Sucker
Family *CYPRINIDAE*	Carp and Minnows
Ptychocheilus oregonsis	Northern Squawfish
P. lucius	Southern Squawfish (Colorado)
Aerocheilus alutaceus	Chiselmouth
Gila robusta	Colorado Gila
G. r. elegans	Swiftwater Colorado Gila
G. r. joradni	Panranagat Roundtail Chub
G. r. seminuda	Virgin River Roundtail Chub
G. r. ssp.	Moapa River Roundtail
G. r. robusta	Roundtail Chub
G. atraria	Utah Gila
G. alvordensis	Alvord Gila
G. bicolor	Tui Chub
G. b. enchila	Fish Creek Tui Chub
G. b. isolata	Independence Valley Tui Chub
G. b. newarkensis	Newark Valley Tui Chub
G. b. obesa	Lahontan Valley Tui Chub
G. b. ssp.	Sheldon Tui Chub
G. cypha	Humpback Chub
G. elegans	Bonytail Chub
Iotichthys phlegethontis	Least Chub
Snyderichthys aliciae	Leatherside Chub
Richardsonius eregius	Lahontan Redshiner
R. balteatus	Columbia Redshiner
R. b. hydrophlox	Bonneville Columbia Redshiner
Family *CYPRINIDAE* (continued)	Carp and Minnows (continued)
Notemigonus crysoleueas	Golden Shiner
Notropis lutrensis	Red Shiner
N. stramineus	Sand Shiner
Rhinichthys osculus	Speckled Dace
R. o. robustus	Lahontan Speckled Dace
R. o. lethoporus	Independence Valley Speckled Dace
R. o. nevadensis	Ash Meadow Speckled Dace
R. o. oligopouis	Clover Valley Speckled Dace
R. o. moapae	Moapa River Speckled Dace
R. o. carringtoni	Snake River Speckled Dace
R. o. velifer	White River Speckled Dace
R. o. yanowi	Virgin River Speckled Dace
R. o. ssp.	Meadow Valley Speckled Dace
R. cataractae	Longnose Dace
R. sp.	Bonneville Speckled Dace
Moapa coriacea	Moapa Dace
Eremichthys acros	Desert Dace
Relictus solitarius	Relict Dace
Cyprinus carpio	Asiatic Carp
Carassius auratus	Goldfish
Orthodon microlepidotus	Sacramento Black ish
Lepidomedia albivallis	White River Spinedace
L. mollispinis mollispinis	Virgin River Spinedace
L. m. pratensis	Panaca Spinedace
L. altivelis	Pahranagat Spinedace
Plagopterus argentissimus	Woundfin
Pimephales promelas	Fathead Minnow
P. vigilax	Bullhead Minnow
Family *ICTALURIDAE*	North American Catfish
Ictalurus punctatus	Channel Catfish
I. catuc	White Catfish
I. nebulosus	Brown Bullhead
I. melas	Black Bullhead
I. m. melas	Northern Black Bullhead
I. m. catulus	Southern Black Bullhead
I. natalis	Yellow Bullhead
Family *CYPRINODONTIDAE*	Killifish
Cyprinodon nevadensis	Amargosa Pupfish
C. n. pectoralis	Warm Springs Pupfish
C. n. mionectes	Ash Meadows Pupfish
C. diabolis	Devils Hole Pupfish
Crenichthys baileyi	White River Springfish
C. b. moapae	Moapa White River Springfish
C. b. grandis	Hiko White River Springfish
C. b. albivallis	Preston White River Springfish
C. b. thermophilus	Mormon White River Springfish
C. nevadae	Railroad Valley Springfish
Empetrichthys merriami	Ash Meadows Springfish
E. latos latos	Pahrump Killifish
Lucania parva	Rainwater Killifish
Fundulus gebrinus	Southwest Plains Killifish
F. kansae	Plains Killifish
Family *POECILIIDAE*	Topminnows
Gambusia affinis	Mosquitofish
Mollienesia latipinna	Black Molly
Xiphophorus helleri	Swordtail
X. maculatus	Moonfish
Family *PERCIDAE*	Perch
Perca flavescans	Yellow Perch
Stigostedion vitreum vitreum	Walleye
Family *CENTRARCHIDAE*	Sunfish
Archoplites interruptus	Sacramento Perch
Micropteres salmoides	Largemouth Bass
M. dolomieui	Smallmouth Bass
Morone saxatilis	Striped Bass
M. chrysops	White Bass
Lepomis macrochirus	Bluegill Sunfish
L. cyanellus	Green Sunfish
Pomoxis nigromaculatus	Black Crappie
P. annularis	White Crappie
Family *COTTIDAE*	Sculpins
Cottus beldingi	Belding (Piute) Sculpin
C. bairdi semiscabei	Bonneville Baird Sculpin
C. bairdi punctulatus	Colorado Mottled Sculpin
C. extensus	Bear Lake Sculpin
C. echinatus	Utah Lake Sculpin

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The dominant species of fish inhabiting streams are listed in Table 2.1-2. Mountain streams contain cold water gamefish such as rainbow trout (Salmo gairdneri), brown trout (S. trutta), subspecies of cutthroat trout (S. clarki), and brook trout (Salvelinus fontinalis). These forms, particularly rainbow trout, are also found in most permanent large area habitats. Cutthroat trout are the only native game fish in the study area, and in many locations the introduced trout species have out competed or hybridized with the native cutthroats. Management policies are now changing in favor of the native cutthroat trout, and many of the existing populations are reintroductions into their historic range.

Slower moving warm water habitats, which are not as common in the siting area as cold water habitats, are populated by introduced largemouth bass (Micropterus salmoides), smallmouth bass (M. dolomieui), white bass (Morone chrysops), green and bluegill sunfish (Lepomis cyanellus and L. macrochirus), channel catfish (Ictalurus punctatus), bullheads (I. sp.) crappie (Pomoxis sp.) and yellow perch (Perca flavescens). Introduced northern pike (Esox lucius) are found in both cold and warm water habitats. Introductions of predatory game fish, such as the bass, in habitats containing native species has often resulted in extirpation of the native fish. Many introduced, non-game fish have had a profound affect on aquatic ecosystems. Asiatic carp (Cyprinus carpio), a valuable food source in other societies, has become a nuisance fish in many habitats. This species is prolific and degrades the habitat by churning up bottom sediments in search of food. Mosquito fish (Gambusia affinis) and other topminnows introduced into many habitats in order to control aquatic insects have often resulted in the destruction of native fish populations through competition for resources, and sometimes predation on eggs or young. Other non-game fish (e.g., threadfin shad, Dorosoma petenense) have been introduced as food sources (forage) for predatory game fish.

Lower Trophic Species: The structure and species richness for lower trophic level organisms in aquatic habitats of the project area are incompletely known. The isolated and highly variable nature of most of the perennial aquatic habitats accounts for the somewhat low diversity and endemic character of many resident biota. Some groups of invertebrates are completely lacking, while others are depauperate in certain habitats. For instance, bivalve molluscs are uncommon in most project area aquatic habitats, especially springs, whereas unique snails are sometimes found as the sole molluscan representative. It is postulated that snails are somehow better able to survive the rigors of the demanding habitats where they are found than are bivalves. Insect and crustacean invertebrates are more widely distributed and less unique in isolated habitats than are molluscs, since they are more easily carried in by birds and winds (as eggs), or by flying in (as adult insects whose larval stages are aquatic). Likewise, phyto- and zooplankton are more easily dispersed by the wind or birds and, thus, are more cosmopolitan. Fast flowing spring heads are by nature depauperate of plankton as the short residence time does not allow planktonic communities to develop. Periphyton and filamentous algae, however, are often abundant and may be planktonic at times.

Organisms tolerant of the stressful water quality conditions characteristic of project area habitats include some snails, amphipods, aquatic beetles, bugs, caddis flies, and true flies (larvae). The following sediment-burrowing and desiccation-tolerant biota apparently withstand many of the stressful conditions better than other organisms: flatworms, nematodes, aquatic earthworms and sowbugs, cased and caseless caddisflies, mites, and pulmonate snails (which can adapt to drying conditions by closing off the opening to their shells). Some stonefly, crustacean, and phytoplankton spores and eggs can withstand long periods of drought common to portions of intermittent and fluctuating habitats.

Aquatic macrophyte vegetation includes submergent and emergent forms, such as rushes (Juncus), Scirpus, spikerush (Eleocharis), and watercress (Rorippa). Floating and attached filamentous algae (Spirogyra, Chara, Tolypothrix tenuis, and Plectonema) and periphyton (primarily diatoms) are the dominant algal forms found in project area aquatic habitats. Phytoplankton in spring and stream habitats are from the attached algal communities, but true phytoplankton communities may develop in lakes, reservoirs, and ponds. The permanence and structure of aquatic vegetation depends upon water level fluctuations, current, and water quality. Vegetation types may be unique in more isolated or unusual habitats, but most species can be transported throughout the area in the gut or on the feet of migratory or resident birds or in the wind as spores or seeds. Thus, most aquatic plants are similar in similar habitats, and different in highly isolated or unique areas that support the growth of unique forms only.

Studies of lower trophic levels in five aquatic habitats of the study area were conducted in June through September 1980 and will be presented in the FEIS. Knowledge regarding the species richness, habitat requirements and interactions will broaden as a result.

2.2 TEXAS/NEW MEXICO

Aquatic Habita

Game Fishing: Sport fishing is identified as one of the most preferred modes of recreation in Nevada and Utah (Nevada State Park System, 1977 and Utah Outdoor Recreation Agency, 1978). There are 351,287 lake acres and 2,589 miles of stream suitable for fishing in Nevada (Nevada State Park System, 1977); in Utah, the figures are 441,400 lake acres and 3,226 miles of fishing stream (Utah Outdoor Recreation Agency, 1978). The area of lakes and streams within the study area is much smaller. Statewide figures are shown because current use patterns indicate willingness to travel long distances to use such resources. The increased cost of fuel has reduced the number of individual trips but has also increased the average length of stay. This change in travel pattern for fishing has not changed the upward trend in the number of fisherman-days in the more rural portions of the basing area.

Revenue for sport fishing management comes primarily from the sale of hunting and fishing licenses in Nevada and Utah (e.g., in Utah, about 90 percent of the fishing management originates form this source). Fish per angler-hour estimates for both Nevada and Utah currently average approximately 3/4 - 1 fish per angler-hour for cold water species (trout, pike). There are substantially higher catch estimates for warm water species (e.g, large mouth bass, white bass, striped bass). There are no commercial fisheries in Nevada. Utah has several small commercial fisheries, but these have been encouraged by Utah State Department of Fish and Game to remove any common and typical nongame fish which are competitors of sport fish. Table 2.2-1 lists gamefish in Nevada and Utah; fishing streams are listed in Tables 2.2-2 and 2.2-3; and the number and lengths of fishing streams in the study area hydrologic subunits are shown in Table 2.2-4.

The Texas/New Mexico High Plains has limited surface water resources. Water-flows in stream courses are generally intermittent except in major river

Table 2.2-1. Game fish in Nevada and Utah.

COMMON NAME	SCIENTIFIC NAME	NEVADA	UTAH
SALMON, TROUT, GRAYLING & WHITEFISH	Family SALMONIDAE		
King Salmon	*Oncorhynchus tsawytscha*	X	
Kokanee Red Salmon	*O. nerka kennalyi*	X	X
Lake Trout	*Salvelinus namayeush*	X	
Brook Trout	*S. fontinalis*	X	
Dolly Varden Trout	*S. malma*	X	
Cutthroat Trout	*Salmo clarki*		
Lahontan Cutthroat Trout	*S. c. henshawi*	FT	FT
Colorado Cutthroat Trout	*S. c. pleuriticus*	X	
Utah Cutthroat Trout	*S. c. Utah*	SE	X
Yellowstone Cutthroat Trout	*S. c. lewisi*	X	X
Humboldt Cutthroat Trout	*S. c.* spp.	X	
Rainbow Trout	*S. gaidneri*		X
Southcoast Rainbow Trout	*S. g. irideus*	X	
Kamloops Rainbow Trout	*S. g. kamloops*	X	
Tahoe Rainbow Trout	*S. g. regalis*	X	
Pyramid Rainbow Trout	*S. g. smaragdus*	X	
Golden Trout	*S. aquabonita*	X	X
Brown Trout	*S. trutta*		X
Arctic Grayling	*Thymallus arcticus*		X
Mountain Whitefish	*Prosopium williamsoni*	X	X
Bonneville Cisco	*P. gemmiferum*		X
Bonneville Whitefish	*P. spilonotus*		X
Bear Lake Whitefish	*P. abyssicola*		X
PIKE	Family ESOCIDAE		
Northern Pike	*Esox lucius*		X
NORTH AMERICAN CATFISH	Family ICTALURIDAE		
Channel Catfish	*Ictalurus punctatus*	X	X
White Catfish	*I. catus*	X	
Brown Bullhead	*I. nebulosus*	X	
Black Bullhead	*I. melas*	X	X
Northern Black Bullhead	*I. m. melas*	X	
Southern Black Bullhead	*I. m. catulus*	X	
Yellow Bullhead	*I. natalis*		X
PERCH	Family PERCIDAE		
Yellow Perch	*Perca flauescens*	X	
Walleye	*Stigostedion vitreum vitreum*		X
SUNFISH	Family CENTRARCHIDAE		
Sacramento Perch	*Archophtes interruptus*	X	X
Largemouth Bass	*Micropteres salmoides*	X	X
Smallmouth Bass	*M. dolomieui*	X	X
Striped Bass	*Morone saxatilis*	X	X
White Bass	*M. chrysops*	X	X
Bluegill Sunfish	*Lepomis macrochirus*	X	X
Green Sunfish	*L. cyanellus*	X	X
Black Crappie	*Pomoxis nigromaculatis*	X	X
White Crappie	*P. annularis*	X	X

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NOTE: FT = federally listed threatened species, caught as a gamefish in Nevada and Utah.
SE = State listed endangered species in Utah, caught as a gamefish in Nevada.

Table 2.2-2. Major fishing streams in Nevada.[1]

COUNTY(s)	STREAM	COUNTY(s)	STREAM
Washoe, Storey, Churchill, Lyon, Carson City, and Douglas Cos.	Desert Sweetwater Thomas Bronco Galena Ash Canyon Clear	Elko Co.	Badger Blue Jacket Bull Run Bruneau Columbia Humboldt (N. & S. Fork) Owyhee (E. Fork) Jarbridge Mary's Lamoille
Nye, Esmeralda, and Mineral Cos.	Chiatovich Indian South Twin Barley Pine Reese Jett	Lander, Pershing, and Humboldt Cos.	Little Humboldt R. (N. Fork) Martin Dutch John Rebel McDermitt Jackson Kings R. Mill Trout Willow Kingston Steiner Birch Big
Clark Co.	Cold Willow		
Eureka, White Pine, and Lincoln Cos.	Roberts Fish Creek Cave Silver Baker Cleve Lehman		

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[1]In all, there are 2,589 miles of suitable fishing streams in Nevada.

Source: Nevada State Park System, 1977.

Table 2.2-3. Streams with good to excellent fishery resources in selected western Utah counties.*

COUNTY	STREAM
Tooele	S. Willow Creek Clover Creek
Juab	Trout Creek Birch Creek Granite Creek Burnt Cedar Creek Sevier River Chicken Creek Pidgeon Creek
Millard	Lake Creek Oak Creek Pioneer Creek Chalk Creek N. Chalk Creek Choke Cherry Creek Meadow Creek Corn Creek S. Fork Corn Creek Maple Grove Springs
Sanpete	Cedar Creek Birch Creek S. Fork Birch Creek S. Spring Creek Cottonwood Creek
Salt Lake	Jordan River City Creek Red Butte Creek Parley Creek Mountain Dell Lambs Canyon R. Fork Lambs Canyon Mill Creek Big Cottonwood Creek Little Cottonwood Creek
Iron	Castle Creek Louder Creek Asay Creek W. Fork Asay Creek Clear Creek Bunker Creek
Piute	Deer Creek Beaver Creek Ten Mile Creek City Creek E. Fork Sevier River Otter Creek Box Creek S. Fork Box Creek Greenwich Creek
Sevier	Otter Creek Salina Creek Gooseberry Creek Meadow Creek Lost Creek Little Lost Creek Glenwood Creek Willow Creek Monroe Creek Doxford Creek Dry Creek Clear Creek Fish Creek Shingle Creek
Washington	Santa Clara River Water Canyon Leeds Creek Mill Creek N. Fork Virgin River

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*Evaluations based on availability of game fish and overall rating of stream reach as per source.

Source: Wydoski, R.S., and Berry C.R., Dec. 29, 1976, *Atlas of Utah Stream Fishing Values*, Logan, Utah.

Table 2.2-4. Number of game fishing streams and their total length for hydrologic subunits within the Nevada/Utah study area.

NUMBER	UNIT NAME	NUMBER OF STREAMS	LENGTH OF STREAMS (mi)	NUMBER	UNIT NAME	NUMBER OF STREAMS	LENGTH OF STREAMS (mi)
4	Snake	15	122	150	Little Fish Creek	4	12
46	Sevier Desert	5	36	151	Antelope	1	5
47	Huntington	26	295	154	Newark	2	8
53	Pine	1	42	156	Hot Creek	2	5
55	Carico Lake	2	16	172	Garden	4	15
56	Upper Reece River	16	108	173b	Railroad - North	6	26
50	Lower Reece River	5	60	174	Jakes -	1	7
134	Smith Creek	3	24	176	Ruby	15	65
137b	Big Smoky - North	23	106	177	Clovis	9	36
138	Grass	4	22	178	Butte	2	10
139	Kobeh	1	8	179	Steptoe	17	93
140	Monitor	11	62	184	Spring	17	99
141	Ralston	1	3	205	Meadow Valley Wash	1	45
149	Stone Cabin	1	2	207	White River	4	37

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Source: Wydoski & Berry, 1976. Nevada Stream Evaluation, 1977.

valleys. There are also areas of isolated springs, primarily along the Pecos River. The flat surface of the plains and the local soil characteristics prevent drainage over wide areas; thus, much of the light rainfall flows into the playa lakes. Most of this water evaporates, with less than 10 percent percolating into the aquifers. This sequence of runoff and evaporation tends to result in fairly mineralized water, and some permanent playa lakes are saline. Adding to the natural salt concentrations are the degrading effects of irrigation return flows, oil field brine leakage, saline groundwater influx, and increased silt load from overgrazed rangeland.

The study area contains two major types of aquatic habitats: (1) river valleys and associated springs, and (2) playa lakes. The first category is represented by three drainages--the Pecos River, Canadian and Arkansas Rivers, and the Red River. The first is a tributary of the Rio Grande; the others are part of the Mississippi drainage. The playa lakes are intermittent to permanent ponds forming in wind-deflation basins. They are consequently not associated with any major drainage systems. These two types of habitat are characterized by very different biotas.

River Systems: The river systems support, or historically supported, various types of riparian habitat, ranging from stands of *Typha* and *Scirpus* to fully developed gallery forests containing an overstory of various species of willows (*Salix*) and cottonwoods (*Populus*) and an understory of associated shrubs, grasses, and forbs. The various vegetation associations are found along both permanent and semipermanent watercourses. However, much of the riparian vegetation has suffered severe alteration, and few areas of woody vegetation remain. Most riparian areas now support only herbaceous cover.

The general ecological importance of riparian habitat has been appreciated only recently. As the only woodland habitat present in the High Plains, it represents a vital resource to non-ground-nesting birds. Johnson et al. (1977), found that 77 percent of the nesting birds in northern Arizona, New Mexico, and west Texas were dependent on habitats associated with water. A number of the threatened and endangered birds found in the study area depend on riparian forests, including bald eagle and osprey. Although similar data on other terrestrial animals are not available, distribution maps of reptiles and amphibians (Stebbins, 1966) show strong association with river valleys, even for upland species whose need for surface water and tall vegetation is not obvious. The general scarcity of permanent aquatic habitats makes most of the associated species sensitive to any changes. Even natural changes in vegetation type drastically alter the faunal composition, as evidenced by changes in mammal species and abundance along the Rio Grande (Boeer and Schmidly, 1977). Detailed descriptions and distributions of both vegetation types and their associated terrestrial faunas are as yet unavailable.

Playa Lakes: More important in the area are the numerous playa lakes, which are wind-deflation basins that are filled by surface runoff from rains. The lakes are variable in size, ranging from several feet to several miles in diameter, and from inches to feet in depth (Rowell, 1971). The vast majority are intermittent, but some of the larger ones are permanent. The basins are lined with Randall clay, a fine reworked soil derived from the surrounding uplands. Because this lining is relatively impermeable, most of the water loss is evaporative. As a result, the lake basins accumulate mineral salts, and some of the permanent lakes are saline. The diversity in size, depth, and salinity makes these lakes difficult to characterize uniformly. Most lack woody or submergent vegetation, although *Zanichellia palustris*, *Naias guadalupensis*, and three species of *Potamogeton* have been reported from the permanent lakes. Some of the emergent species common to many of the lakes, intermittent and permanent, are Scirpus acutus, S. supinus, Typha domingensis, and species of Polygonum, Sida, Ranunculus, Eleocharis, and Heteranthera (Rowell, 1971).

The playa lakes are scattered throughout an area of intensive agriculture and, as a result, up to 85 percent of the lakes in Texas are modified to some extent (Bolen 1980). In dry years, the small lakes are often farmed, or at least plowed, damaging the native vegetation or eliminating it altogether. Other lakes have been artifically deepened to conserve water for agricultural use or recreational fishing, for which purpose species such as channel catfish and sunfishes are stocked, along with bait animals. This deepening causes a reduction of lake surface area and loss of shallow water, drastically reducing the area of emergent vegetation (Bolen, et al., 1979).

Playa lakes are the major open-water aquatic habitat of the High Plains. Large numbers of waterfowl use the lakes for overwintering. Buffalo Lake and Muleshoe National Wildlife Refuges have supported over one million ducks in peak years, and these areas represent a fraction of the total lake surface acreage. There is also evidence that mallard (Anas platyrhynchos), pintail (A. acuta), bluewinged teal (A. discors), cinnamon teal (A. cyanoptera), and redhead (Aythya americana) use the playa lakes for breeding (Bolen et al., 1979). In addition, numerous shorebird species, such as long-billed curlew (Numenius americanus) and avocet (Recurvirostra americana), and other birds associated with water, such as sandhill cranes (Grus canadensis), marsh hawks (Circus cyaneus), and Mississippi kites (Ictinia mississippiensis) utilize the playas. These waterfowl are supported by seeds from emergent vegetation, especially wild millet (Echinochloa crus-galli) and tearthumb (Polygonum spp.), and invertebrate populations, primarily phyllopod crustaceans such as clam shrimp (Lynceus brevifrons, Caenesteriella setosa), tadpole shrimp (Triops longicaudatus), and fairy shrimp (Streptocephalus texanus, S. dorothae) (Sublette and Sublette, 1967). The lakes also support populations of aquatic beetles, corixids, midges, snails, worms, and other invertebrates in smaller numbers than the crustaceans. Spadefoot toads (Scaphiopus spp.) and salamanders (Ambystoma tigrinum) use the playa lakes for breeding; there is some evidence that young waterfowl feed on both invertebrates and tadpoles.

Modified playas are less suitable for waterfowl than unmodified ones for several reasons. The area of emergent vegetation on unmodified lakes can be 24 times as large as on modified lakes, providing far more cover and food for herbivorous species, such as blue-winged teal (Rollo and Bolen, 1969). There is also a strong correlation between area of emergent vegetation and invertebrate abundance, and a strong correlation between invertebrate abundance and brood production. Interestingly, intermittent lakes consistently supported higher invertebrate biomass than permanent lakes. Thus, unmodified intermittent playa lakes provide the best available habitat for waterfowl, both breeding and wintering, on the High Plains (Bolen et al., 1979).

Since the Texas High Plains is clean farmed, most of the available wildlife cover is provided by the vegetation associated with playa lakes. Pheasants (Phasianus colchicus), cottontails (Sylvilagus spp.), and raccoons (Procyon lotor) use this vegetative cover (Bolen et al., 1979). Playa lakes also serve as water sources for terrestrial animals. Pronghorn (Antilocapra americana) abundance was historically correlated with playa water. Unfortunately, quantitative data on use of the playas by wildlife are lacking, although more studies are underway.

Virtually nothing is known of the status of these lakes in the New Mexico High Plains region. As the area is primarily rangeland, agricultural modifications are unlikely. However, intensive use by range cattle can cause severe damage to the native vegetation (Bolen et al., 1979), so it is possible that the playas in New Mexico are as threatened by range use as are those in Texas by intensive agriculture.

Aquatic Biota

Fishes: Approximately 75 species of fishes have been reported from the Texas/New Mexico High Plains study area. As can be seen in Table 2.2-5, many of the species are common to all three river systems and in fact are found throughout drainages east of the Rockies. Even the one species in the study area considered threatened by Texas, the blue sucker (*Cycleptus elongatus*), is common elsewhere in the Mississippi drainage. A number of the species in the Pecos River, which also inhabit the Canadian and Red Rivers, have been introduced; examples of these are yellow perch (*Perca flavescens*) and various sunfishes (*Lepomis* spp.). The Canadian and Red Rivers, as part of the Mississippi drainage, have nearly identical fish faunas.

The Pecos River, however, being a tributary of the Rio Grande, has a number of distinguishing species including some endemics restricted to springs and seeps in the Pecos Valley but not in the river proper. The Rio Grande drainage species are roundnose minnow (*Dionda episcopa*), Rio Grande shiner (*Notropis jemezanus*), and bigscale logperch (*Percina macrolepida*). The Pecos River endemic species, Pecos pupfish (*Cyprinodon* sp.) and Pecos gambusia (*Gambusia nobilis*), are restricted to sinkholes and clear-water springs, perhaps forced into these refugia by the deteriorated water quality of the major streams. All are found at Bitter Lakes National Wildlife Refuge, and have populations in isolated springs and sinkholes elsewhere.

Thirty species of fish in the area have some commercial or sport value (see Table 2.2-5). However, since many of the aquatic habitats are highly mineralized or intermittent, production of preferred game or food fish is not favorable. The existing populations of larger fish are often dominated by generally undesirable species such as gizzard shad (*Dorosoma cepedianum*), carp (*Cyprinus carpio*), carpsucker (*Carpiodes carpio*), and gray redhorse (*Moxostoma congestum*). Populations of sunfishes (*Lepomis* spp.) and catfishes (*Ictalurus* spp.), which are desirable as food species (Campbell, 1957; Lewis, 1960; Henderson, 1964 and 1968), occur in some areas.

Lower Trophic Species: The invertebrate faunas of aquatic habitats in the Texas/New Mexico study area are not well-studied, but some general observations can be made. Mollusks, some species of crustaceans, and numerous species of larval and adult insects are the dominant invertebrates to be encountered in aquatic environments of the region. The high salt content and/or the intermittent nature of many of the waters likely restricts the diversity of freshwater invertebrate species present. Organisms tolerant of low-to-moderate salt concentration would include several species of phyllopod crustaceans, snails (Gastropoda), scuds (Amphipoda), and aquatic insects represented primarily by species of beetles (Coleoptera), bugs

Table 2.2-5. Fishes of the Texas/New Mexico study area.

SPECIES NAME	COMMON NAME	STATUS	DRAINAGE		
			P[1]	C[2]	R[3]
Lepisosteus spatula	alligator gar	S.C.[4]			X
L. osseus	longnose gar	S.C			X
Dorosoma cepedianum	gizzard shad		X	X	X
Esox lucius	northern pike	S		X	X
Hiodon alosoides	goldeye			X	X
Astyanax mexicanus	Mexican tetra		X	X	
Cucleptus elongatus	blue sucker		X		X
Icciabus bubalus	smallmouth buffalo	S.C.	X		X
I. cyprinellus	bigmouth buffalo	S.C.			X
I. niger	black buffalo		X		X
Carpoides carpio	river carpsucker	C	X	X	X
Catostomus commersoni	white sucker		X	X	
Cyprinus carpio	carp	S.C	X	X	X
Gila nigrescens	Rio Grande Chub		X	X	
Chrosomus erythrogaster	redbelly dace			X	
Semotilus atromaculatus	creek chub		X	X	
Phenacobius mirabilis	suckermouth minnow			X	
Dionda episcopa	roundnose		X		
Hybopsis gracilis	flathead chub		X	X	
H. aestivalis	speckled chub		X	X	X
Hybognathus placita	plains minnow		X	X	X
H. nuchalis	silvery minnow				X
Pimephalus vicilas	bullhead minnow	C			X
P. promelas	fathead minnow	C	X	X	X
Campostoma anomalus	stoneroller		X	X	X
Carassius auratus	goldfish			X	X
Notropis jamaranus	Rio Grande shiner		X		
N. lutrensis	red shiner	C	X	X	X
N. stramineus	sand shiner	C	X	X	X
N. girardi	Arkansas River shiner			X	X
N. percobromus	plains shiner				X
N. oxyrhynchus	sharpnose shiner			X	
N. shumardi	silverband shiner			X	
N. blennius	river shiner			X	X
N. potteri	chub shiner			X	X
N. buccula	smalleye shiner			X	
N. venustus	blacktail shiner	C		X	
N. volucellus	mimic shiner			X	
N. buchanani	ghost shiner			X	
Notemigonus chrysoleucas	golden shiner	C		X	X
Ictalurus punctatus	channel catfish	S.C	X	X	X
I. furcatus	blue catfish	S.C	X	X	X
I. melas	black bullhead	S.C	X	X	X
I. natalis	yellow bullhead	S.C	X	X	X
I. lupus	headwater catfish		X		
Noturus gyrinus	tadpole madtom			X	
Pylodictis olivaris	flathead catfish		X	X	X
Anguilla rostrata	American eel		X		
Fundulus kansae	plains killifish		X	X	X
F. zebrinus	southwestern killifish		X		
Lucania parva	rainwater killifish		X		
Cyprinodon rubrofluviatilis	Red River pupfish			X	X
C. sp.	Pecos pupfish		X		
Gambusia affinis	mosquitofish		X	X	
G. nobilis	Pecos gambusia		X		
Morone chrysops	white bass	C		X	X
Micropterus salmoides	largemouth bass	S			
M. punctulatus	spotted bass	S	X		X
Lepomis gulosus	warmouth	S	X	X	
L. auritus	yellowbelly sunfish	S			X
L. cyanellus	green sunfish	S		X	X
L. punctatus	spotted sunfish			X	
L. microlophus	redear sunfish	S	X	X	X
L. macrochirus	bluegill	S	X	X	X
L. humilis	orange-spotted sunfish	S		X	X
L. megalotis	longear sunfish	S	X	X	X
Pomoxis annularis	white crappie	S	X	X	
P. nigromaculatus	black crappie	S	X		
Perca flavescens	yellow perch	S	X		
Etheostoma lepidum	greenthroat darter		X		
E. spectabile	orangethroat darter			X	
Stizostedion vitreum	walleye			X	
Percina caprodes	logperch			X	X
Percina macrolepida	bigscale logperch		X		
Aplodinotus grunniens	freshwater drum	S.C		X	X
Moxostoma congestum	gray redhorse		X		X
N. bairdi	Red River shiner				X

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P = Pecos

C = Canadian and Arkansas

R = Red

S = Sport; C = Commercial

(Hemiptera), caddisflies (Trichoptera) and flies (Diptera) (Pennak, 1953). Although many of the water bodies in the area are intermittent, they do retain water for varying periods of time. Such water bodies often function as refuges for some species and as temporary habitat for others. These would include aquatic invertebrates such as:

- Species that survive by burrowing into the substrate. This group comprises flatworms (Turbellaria), nematodes (Nematoda), aquatic earthworms (Oligochaeta), crayfish (Decapoda), scuds and aquatic sowbugs (Isopoda), small crustaceans, beetles, some caseless caddisflies, and some midges (Chironomidae), snails, and mites (Acari).
- Species such as phyllopod crustaceans and stoneflies (Plecoptera), whose eggs or immature forms are able to survive long periods of drought.
- Species that reinvade from elsewhere as soon as water returns. Certain mayflies (Ephemeroptera) and blackflies (Simulidae) appear in this group.
- Species such as certain mosquitoes (Culicidae), midges and other flies, beetles, and a variety of bugs that occupy pools or the damp parts of a stream bed only during the dry period or during the early stages of the dry period.
- Highly specialized inhabitants of temporary waters, such as a few snails and caddisflies, which adapt to dry conditions by closing off the opening to their shells or cases (Hynes, 1970).

Fishing: Ponds, playas, and lakes less tahn 40 surface acres are the primary fishing habitats in the Texas and New Mexico High Plains study area; 25 percent of the playas are throught to contain significant amounts of water throughout the year. In a special 1976 report prepared by the U.S. Department of Agriculture in cooperation with several Texas agencies, it was assumed that ponds are primarily on private lands generally not open for public use and that ony 48 percent of the fishing habitat in the High Plains is accessible for public use. The report estimates a need in the High Plains for 1,6000 surface acres of lakes in 1975 to 2,500 acres in 2020 to meet the expected fishing demand.

3.0 PROJECT IMPACTS

3.1 NEVADA/UTAH

Siting M-X in the Nevada/Utah area would impact aquatic habitats and species through construction activities, system operation, and increased numbers of people in the area. Table 3.1-1 provides a summary of potential impacts. The types of impacts expected include degradation of surface water quality, physical alteration of aquatic habitats, and reductions in surface water volume and surface area resulting from groundwater withdrawal. Each would have the potential to cause significant adverse impacts to aquatic species. Table 3.1-2 shows a value rating of impacts based on abundance and sensitivity to impact of selected native fish. These fish species were selected as (1) taxa sensitive to potential M-X impacts, either through direct (construction activities) or indirect (human recreation) sources, or (2) species of special interest to the residents of the basing area. Similar information for game fish is presented in Table 3.1-3.

Construction: As estimated in the Technical Report on Water Resources, the maximum annual water use for construction activities would be approximately 27,000 acre-ft ($3.35 \times 10^7 m^3$). Since such volumes are not available as surface resources, groundwater resources would be required. All types of project-related development (including roads and urban centers) would require withdrawal of water from aquifers either within the valleys utilized or from nearby valleys which have a large perennial yield that is not currently allocated. An example of a valley which has a large, unused perennial yield is Spring Valley. Its estimated perennial yield is from 70,000 to 100,000 acre-ft per year (8.7 to $12.4 \times 10^7 m^3/yr$) (Rush and Kazmi, 1965).

Groundwater withdrawal could impact aquatic habitats on a site-specific basis throughout the siting area if well placement and operation are not accurately engineered and managed. The extent and significance of the potential impacts from groundwater withdrawal would be expected to be minimized through good management practices. However, in some geographically limited areas, where project intensity is high and the available water (perennial yield minus current use) is low, there would be a potential for significant impacts to aquatic habitats, particularly those in valley bottoms. As a result of slow soil/rock transmissivities, impacts could occur several years after water withdrawal for construction. (For more specific information on groundwater withdrawal and potential impact location, see the Technical Report on Water Resources.) Many topographically closed valleys in the deployment area are hydrologically connected to other valley systems. This is particularly apparent in the valleys surrounding the White River/Muddy (Moapa) River system (Eakin, 1966). Increased groundwater withdrawal in any valley could result in a decrease in water volume for springs which are in the cone of depression around the withdrawal point. Valley bottom habitats would be the most likely to be affected while little or no effect could be expected for those in the mountains. Affected perennial streams would be expected to show a decrease in length and stream flow while water levels in groundwater fed lakes and ponds could be lowered. Groundwater mining in areas where several valleys are hydrologically connected could result in impacts to aquatic habitats a considerable distance away from the point of withdrawal, even in other valleys which are topographically isolated from the withdrawal point. As a result of physical changes to aquatic habitats, many biotic features would be expected to change. The generalized loss of habitat could

Table 3.1-1. Summary of potential general project effects on aquatic species, Nevada/Utah. (page 1 of 2)

PROJECT PARAMETER	SECONDARY EFFECTS	AQUATIC SPECIES	REFERENCES
	Construction		
Area disturbed			
	Fugitive dust	Minimal effects predicted.	
	Erosion and siltation	Chemicals in rainfall runoff from new asphalt roads, cement production, dust suppression activities, and accidental petrochemical spills could temporarily impact some protected organisms.	Deacon, et al. 1979b; Hynes, 1976; Cummins & Klug, 1979
		Siltation in aquatic habitats could be locally important.	
		All species (both game and non-game species population could be reduced. Phyto plankton and periphyton productivity decreased, gill breathing and filter-feeding organisms smothered or starved.	Armour, 1977; Hutchinson & Collins, 1978; Phillips, et al, 1975; Platts, 1979
	Loss of vegetation	Destruction of aquatic habitat and its associated vegetation could destroy endemic fish populations and reduce game fish productivity.	Pister, 1974; Platts, 1979; Armour, 1977
	Presence of machinery and people	Minimal impact predicted other than those discussed in recreation.	
	Operations		
	Fugitive dust	Minimal impacts predicted.	
	Erosion	Some impact similar to construction but at a lower level.	
	Revegetation of disturbed areas	Beneficial impact would result by decreasing erosion/sedimentation and re-establishing condition similar to those of the pre-project.	Keller, et al, 1979
	Transmission lines	No impact predicted.	
Water use	Lowering of water table	Valley bottom habitat reduction or loss and extinction or extirpation of isolated populations. Mitigation by transplanting or alteration of well water pumping rates and/or location.	Deacon, et al, 1979; Minckley & Deacon, 1978; Hardy, 1980
		Feeding and spawning habitat reduced.	Williams, 1977; Fiero & Maxey, 1970; Bateman, et al, 1974; Dudley & Larsen, 1976; Pister, 1974
Vehicle traffic	Fugitive dust	Minimal impacts predicted.	

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Table 3.1-1. Summary of potential general project effects on aquatic species, Nevada/Utah. (page 2 of 2)

PROJECT PARAMETER	SECONDARY EFFECTS	AQUATIC SPECIES	REFERENCES
People Construction	Sewage	In habitats near area of rapid population growth, some reduction in water quality is expected (e.g., Ely, Alamo, Moapa, and Delta). Nuisance algae blooms expected.	
	Solid waste	None predicted.	
	Introduction of exotic species	Non-natives may outcompete endemic aquatic species, may introduced and eliminate endemics through habitat competition and/or diseases.	Deacon, et al., 1974; Walstrom, 1973; Bickhar & Duff, 1978; Minckley, et al., 1977.
Operations			
During construction, people will be dispersed throughout deployment area. During operations, people and effects will be concentrated in the vicinity of operating bases.	Recreation ORV use	Increases access to pristine habitats. Damages benthic sediments. Locally increased turbidity and degraded water quality due to waste disposal. (See erosion and siltation.)	Walstrom, 1973
	Camping and hiking	Trampling of pristine areas, waste disposal and littering can result in local erosion/sedimentation and water pollution problems.	Walstrom, 1973
	Fishing	Possible depletion of native cutthroat trout by preferential capture. Further depletion by increased fishing pressure.	Diernnider, May 1980; Walstrom, 1973; Behnka and Zan, 1976
	Poaching	Similar to normal fishing pressure but less intense.	
	Swimming	Disturbance of species behavior, increased turbidity, habitat deterioration. Loss of desirability of fishery.	Walstrom, 1973; Manning, 1979

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Table 3.1-2. Abundance and sensitivity to impact for native fishes, Nevada/Utah.

NUMBER	LOCATION	A	S	NUMBER	LOCATION	A	S
3	Deep Creek	L	L	152	Stevens	L	L
4	Snake	H	H	153	Diamond	I	I
5 (U)	Pine	L	L	154	Newark	H	I
6	White	I	H	155	Little Smokey	I	I
7	Fish Springs	I	H	156	Hot Creek	H	I
8	Dugway	L	L	169a	Tikaboo Northern	L	L
9	Government Creek	L	L	170	Penover	L	L
13	Rush	L	L	171	Coal	L	L
32b	Great Salt Lake Desert-Western	L	L	172	Garden	L	L
46	Sevier Desert	L	L	173a	Railroad-Southern	L	L
46a	Sevier Desert-Dry Lake	L	L	173b	Railroad-Northern	I	I
47	Huntington	I	I	174	Jakes	L	L
50	Milford	L	L	175	Long	L	L
52	Lund District	L	L	176	Ruby	H	I
53 (N)	Pine	L	L	178	Butte	L	L
53 (U)	Beryl-Enterprise District	L	L	179	Steptoe	H	H
54 (U)	Wah Wah	L	L	180	Cave	L	L
54 (N)	Cresent	L	L	181	Dry Lake	L	L
55	Carico Lake	L	L	182	Delamar	L	L
56	Upper Reese River	I	I	183	Lake	L	L
57	Antelope	L	L	184	Spring	H	H
58	Middle Reese River	I	I	185	Tippett	L	L
122	Gabbs	L	L	186	Antelope	L	L
124	Fairview	L	L	187	Goshute	L	L
125	Stingaree	L	L	194	Pleasant	L	L
126	Cowkick	L	L	196	Hamlin	L	L
127	Eastgate	L	L	198	Dry	L	L
133	Edwards Creek	L	L	199	Rose	L	L
134	Smith Creek	L	L	200	Eagle	L	L
135	Ione	L	L	201	Spring	L	L
136	Monte Cristo	L	L	202	Patterson	I	H
137	Big Smoky-Tonopah Flat	L	L	203	Panaca	I	H
137b	Big Smoky-North	H	H	204	Clover	L	L
138	Grass	I	I	205	Meadow Valley Wash	H	I
139	Kobeh	L	L	206	Kane Springs	L	L
140	Monitor	H	H	207	White River	H	H
141	Ralston	L	L	208	Pahroc	L	L
142	Alkali Sorings	L	L	209	Pahranagat	H	H
143	Clayton	L	L	210	Coyote Springs	L	L
144	Lida	L	L	219	Muddy River Springs	H	H
149	Stone Cabin	I	I	128	Dixie	L	L
150	Little Fish Lake	L	L	129	Buena Vista	L	L
151	Antelope	L	L	132	Jersey	L	L

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Fish included in this analysis are: cutthroat trout, desert sucker, roundtail chubs, least chub, tui chubs, speckled dace, desert, moapa and relict dace, spinedace, springfish, and killifish.

H = high

I = intermediate

L = low

U = Utah

N = Nevada

A = abundance, denoting frequency of resource occurrence.

S = Sensitivity, relating to a combination of factors including (a) location and/or potential exposure of the resource to project effects, and (b) resource abundance. The criteria used for defining sensitivity levels are contained in the base reference document.

Table 3.1-3. Abundance and sensitivity to impact for game fish, Nevada/Utah. (page 1 of 2)

HYDROLOGIC SUBUNIT		A	S
NO.	NAME		
3	Deep Creek	L	L
4	Snake	H	I
5 (U)	Pine	L	L
6	White	L	L
7	Fish Springs	L	L
8	Dugway	L	L
9	Government Creek	L	L
13	Rush	L	L
32b	Great Salt Lake Desert-Western Desert	L	L
46	Sevier Desert	I	H
46a	Sevier Desert-Dry Lake	L	L
47	Huntington	H	I
50	Milford	L	L
52	Lund District	L	L
53 (N)	Pine	I	I
53 (U)	Beryl-Enterprise District	L	L
54 (U)	Wah Wah	L	L
54 (N)	Crescent	L	L
55	Carico Lake	I	I
56	Upper Reese River	H	I
57	Antelope	L	L
58	Middle Reese River	I	I
122	Gabbs	L	L
124	Fairview	L	L
125	Stingaree	L	L
126	Cowkick	L	L
127	Eastgate	L	L
133	Edwards Creek	I	I
134	Smith Creek	I	I
135	Ione	L	L
136	Monte Cristo	L	L
137a	Big Smokey-Tonopah Flat	L	L
137b	Big Smokey-North	H	I
138	Grass	I	I
139	Kobeh	I	I
140	Monitor	I	H
141	Ralston	I	I
142	Alkali Spring	L	L
143	Clayton	L	L
144	Lida	L	L
149	Stone Cabin	I	I
150	Little Fish Lake	I	I

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Table 3.1-3. Abundance and sensitivity to impact for game fish, Nevada/Utah. (page 2 of 2)

HYDROLOGIC SUBUNIT		A	S
NO.	NAME		
151	Antelope	I	L
152	Stevens	L	L
153	Diamond	I	I
154	Newark	I	I
155	Little Smokey	I	I
156	Not Creek	I	L
169a	Tikaboo-Northern	L	L
170	Penoyer	L	L
171	Coal	L	L
172	Garden	I	I
173a	Railroad-Southern	L	L
173b	Railroad-Northern	I	H
174	Jakes	I	I
175	Long	L	L
176	Ruby	H	I
178	Butte	I	I
179	Steptoe	H	I
180	Cave	L	L
181	Dry Lake	L	L
182	Delamar	L	L
183	Lake	L	L
184	Spring	H	I
185	Tippett	L	L
186	Antelope	L	L
187	Goshute	L	L
194	Pleasant	L	L
196	Hamlin	L	L
198	Dry	L	L
199	Rose	L	L
200	Eagle	L	L
201	Spring	L	L
202	Patterson	L	L
203	Panaca	I	H
204	Clover	L	L
205	Meadow Valley Wash	I	I
206	Kane Springs	L	L
207	White River	I	I
208	Pahroc	L	L
209	Pahranagat	L	L
210	Coyote Springs	L	L
219	Muddy River Springs	I	L
128	Dixie	I	I
129	Buena Vista	I	I
132	Jersey	L	L

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A = Abundance

S = Sensitivity to impact

H = High; I = Intermediate; L = Low

result in the loss of specific portions (small features) within each habitat (Dudley and Larsen, 1976). Many of these small features (e.g., ledges in springs) have been demonstrated to be critical for the existence and maintenance of small populations of native organisms. Lowering of the surface levels of springs, lakes, and ponds would be expected to adversely alter many species interactions (e.g., predation and competition) because of the loss of spatial segregation in the water column. Pond and lake area reductions would reduce the migratory waterfowl habitat available. The changes in water level would modify several physical factors of aquatic habitats (e.g., temperature profile, light penetration, flow rates) which are commonly controlling factors of growth of lower trophic level organisms (Hutchinson, 1967).

Many of the valleys proposed for extensive groundwater withdrawal have significant habitats that should be protected from impact. As an example, the pluvial White River system, as a hydrologic groundwater system, has three valleys listed as possibly containing sufficient amounts of groundwater to supply the needs of a missile shelter prefabrication site (Fugro, 1980). These valleys are Coal, Garden, and White River. These valleys, along with Long, Jakes, Dry Lake, Delamar, Cover, Pahranagat, Kane Springs, Coyote Springs, and the Moapa valleys, form the hydrological unit which supplies the water source to the springs and streams of the White River, Pahranagat, and Moapa valleys. Withdrawal upgradient, in this case generally northward, would result in loss of groundwater flow lower in the groundwater unit. Withdrawals from upper White River, Coal and/or Garden Valley would be expected to result in a decrease in flow in the springs of Pahranagat Valleys, such as Ash and Crystal Springs. If the volume of withdrawal water were high enough in White River Valley the ten springs inhabited by native species would be expected to have decreased flow and loss of habitat. The ten springs contain four species protected by federal or state laws (Hardy, 1979). In addition, these springs contain ten other species recommended for protection by regional authorities. Water withdrawal which resulted in the loss of these habitats would be an important impact to the native protected fauna. Groundwater withdrawal from some of the proposed IOC valleys (Dry Lake and Delamar) would also influence spring and valley bottom stream habitats in Pahranagat, Coyote Springs and Moapa valleys. Modification of aquatic habitats in the White River hydrologic system would impact the White River springfish (Crenichthys baileyi ssp.), spinedace (Lepidomedia albivallis), desert sucker (Pantosteous clarki), and speckled dace (Rhinichthys osculus velifer); the Pahranagat roundtail chub (Gila robusta jordani); the Moapa River roundtail (G.r ssp.); the Moapa dace (Moapa coriacea); and the Moapa River speckled dace (R.o. moapa). Expected impacts to these and other protected species are described in ETR-17 (Protected Species).

Physical alteration of aquatic habitats resulting from construction activities, other than those affecting water quality or resulting from groundwater withdrawal, would be limited to the direct use of machinery in aquatic habitats. The loss of aquatic habitats from physical alteration should be limited in extent and potentially significant in only a few isolated cases. Streambeds and downstream flow regimes would be disturbed during construction of road crossings (e.g., bridges, culverts, or fords). This would destroy the benthic community by crushing and covering. Operation of heavy machinery near sensitive springs, many of which are very small in size, could cause collapse of their overhung banks, thereby destroying a substantial amount of aquatic habitat.

Many of the projected activities related to M-X construction would increase erosion rates and, therefore, sediment loading of downstream or downslope aquatic systems. With the exception of DTN segments through the mountains, such impacts would occur primarily in a few valley bottom springs or reservoirs. Most valley bottom aquatic habitats in the Great Basin when undisturbed have very clear waters. An influx of suspended sediment would increase turbidity and sedimentation in these habitats which would adversely affect resident biota. Respiration of fish and invertebrates could be impaired by clogging of their gills, visual feeding would be reduced, benthic sediments would be altered, and primary productivity of algae and submerged macrophytes would be reduced. Most soil redistribution processes, particularly those near streambeds, would result in an increase in sediment load of nearby aquatic environments. Areas where native groundcover has been removed, thereby exposing the soil to larger erosive forces, would be a major source of sediment. Likewise, areas of cut and fill operations would be regions of high erosion potential. Any required changes to stream channels, such as stream crossings and channel relocation projects, would release large amounts of sediment. Temporary impoundment and/or diversion of stream flows from one channel to another would be expected to increase stream sediment carrying capacity as a result of increased stream velocities.

An increase in sediment load from the construction activities described above, although limited in geographical extent, would be regarded as a negative and potentially significant impact to aquatic habitats and communities. Streams with heavy suspended sediment loads are less aesthetically appealing to anglers (Manning, 1979). In addition, fine grain sediment deposition in spawning areas impedes the flow of dissolved oxygen through the intragravel spaces. This causes the developing embryos to become oxygen-starved and allows the accumulation of metabolic wastes (Phillips et al., 1975). Sediment deposition also fills instream cover (gravel interstices) which are vital to the survival of young fish as protection from predation (Platt, 1979). High erosion of streambanks results in the physical loss of bank habitat and the transport of portions of the habitat and organisms downstream. Upon deposition, all in situ benthic life would be covered with a layer of unconsolidated material. This would not only result in the death of most of the benthic biota but would also result in the loss of some habitats required by fish (e.g., gravel bottom spawning grounds). Further loss of streambanks, particularly in smaller streams, would also adversely impact fish population densities (Platt, 1979). Fish use streambank edge habitat for cover (riparian vegetation), control of water velocity, and a source of incoming terrestrial foods. The addition of sediment to aquatic systems would result in changes to the trophic and community structures in these habitats (Kaster and Jacobi, 1978). Mobile organisms which require hard substrates would be crowded and would, thereby, be subject to increased predation. (Non-mobile organisms would be buried by settled sediment). Locations of siltation would be expected to cause changes in species composition (Platt, 1979). The benthic oxygen regime would very likely go from aerobic to anaerobic. The light path in the water column would be both decreased and spectrally altered affecting primary productivity. The addition of sediment to surface water would result in water quality changes, particularly to pH and total dissolved solids (TDS) (Varma, 1979). Finally, the diversion of waters from one source into another watercourse could result in the accidental transfer of non-native species from one habitat to another. Unplanned introductions of non-native species would significantly impact the native biota on a site-specific basis (Hardy, 1979). All of the above listed impacts are currently affecting aquatic communities in the study area. Deployment of the M-X system would be expected to accelerate the trend of habitat degradation.

Construction activities would be expected to increase the introduction of other pollutants. Most of these pollutants can be contained or treated to reduce potential impacts. These pollutants (e.g., oils and herbicides), although occurring during construction activities in small amounts, would be expected to have a higher incidence of occurrence during the longer operational phase. A more complete discussion of these impacts can be found below.

Indirect impacts to aquatic habitats during construction would result primarily from the increased number of people present in formerly sparsely settled areas. Construction of additional housing, transportation networks, and their attendant features (e.g., parking lots) would reduce the groundwater recharge potential through covering the soil with impervious surfaces or recompaction of soils. This would increase local erosion potential by increasing runoff volumes and velocities. Increases in runoff volume and velocities would be expected to result in an increase in water volumes which would eventually rest in the bajadas of each watershed. The bajadas are areas of high evaporative loss and low infiltration. Therefore, these waters would be lost to the normal groundwater recharge system. (For fuller explanation of the hydrologic system see the Water Resources Technical Report ETR-12).

Recreational activities are likely to concentrate near or in aquatic habitats causing additional impacts. Water quality would be adversely impacted by non-point source pollutants, runoff of suspended sediments from upstream watershed use for recreational activities (particularly ORVs), and possible overloading of existing wastewater treatment facilities. (Construction of new wastewater treatment facilities are planned for the proposed OBs.) Aquatic habitats would also be physically impacted because of increased human contact for various recreational purposes. Existing game fishing areas would experience a significant increase in fishing pressure. This increased pressure would probably require enhanced stocking of native and introduced game fish to supplement native fish yield. The introduction of exotic fish through stocking for recreation or release of aquarium fish would result in an extremely adverse impact to native fish, and increased protection of native fish habitats may be required or some native fish species may be extirpated (Hardy, 1979; Dieringer, 1980). Deliberately and accidentally introduced non-native fish species have been one of the key factors in the dramatic trend of native species extinctions and reductions that have occurred in the southwest in the past century. All aquatic habitats are likely to receive some increase in recreational pressure and contamination during the construction period.

Operations: Operation of the proposed M-X system would have the same types of impacts to aquatic habitats and species as those listed for construction activities; however, the intensity and exact location of these impacts would be modified. Groundwater withdrawal would be principally limited to waters used for domestic needs. This is estimated to be a maximum of approximately 10,000 acre-ft/year (1.24×10^7 m^3) or approximately 37 percent of the maximum one-year use during construction. Furthermore, water use during operations would be concentrated near the OBs and support communities with lesser amounts used at the dispersed support facilities (e.g., security stations).

No direct physical alteration of aquatic habitats would be expected from operational activities. Indirect physical impacts should be similar in nature but more intense than those listed under construction, particularly near the OBs where recreational use would be expected to be higher. This would cause more recreational pressure on the limited aquatic habitats and resources. Prior construction activities affecting habitat quality, particularly sedimentation, would be expected to continue impacting aquatic species during operations.

Pollutants, other than sediments listed under construction, which could adversely impact local water quality, would be introduced to aquatic systems from centralized point sources or from dispersed areas (non-point sources). The expected point sources would be from domestic wastewater outfalls at the OBs and support communities, increasing the nutrient load and oxygen demand on downstream habitats, and from industrial processes discharging effluent with elevated temperature and a wide variety of dissolved and suspended particulate wastewaters. Such industrial sources would be very localized and most likely to be in areas already having industrial development. Non-point source pollutants would originate from a wide range of land-use options, including parking lots, roads, lawn irrigation, and air pollution fallout. These would also be concentrated in the vicinity of the OBs and support communities but could also occur throughout the potential deployment area as a result of project maintenance and operation. The composition of these pollutants is as varied as their sources, encompassing oils, greases, solvents, pesticides, human excrement, dusts, heavy metals, and salts.

Domestic wastewater discharges would be expected to be controlled through the proper application of existing technologies. Since water is a scarce commodity in much of the Great Basin, wastewater sources could be used to the advantage of the area surrounding the OBs through reclamation. The accidental or occasional direct discharge of treated domestic wastewaters to aquatic habitats would locally accelerate the eutrophication process through the addition of soluable nutrients, particularly nitrogen and phosphorus. Eutrophication of the aquatic habitat would result in major changes in aquatic community structure, loss of aesthetic appeal of the watercourse, degradation of the fishery, and proliferation of nuisance species, such as decaying algal mats (Hutchinson, 1967).

Collection, treatment, and reuse of discharge of industrial effluents would be somewhat more difficult and expensive than for typical domestic wastewater (Fox and Treweek, 1980). Industrial effluents produced by M-X operational acitivities would be small in volume and limited to OB locations with DAAs. As a result of the diversity and unpredictability of pollutant species in plausible effluents, detailed impact analysis of each industrial effluent is not possible at this time. However, determination of certain generic impacts is possible. Although these pollutants would be very limited in volume, they could pose a significant threat to aquatic systems. Introduction of thermal effluents to cold-water habitats could dramatically impact the resident biota, since an increase in water temperature would increase community metabolic rate while decreasing dissolved oxygen levels. Thermal effluents may be reused for heating or industrial processes, or they may be cooled before discharging to existing surface waters. Many other industrial pollutants would not be expected to be immediately recycleable. Hazardous wastes would be required to be contained and disposed of in an approved manner. Introduction of oils, solvents, hazardous fluids, radioactive materials, heavy metals, mining spoils, combustion by-products and all other toxic contaminants, although very rare in occurrence, would result in significant impacts to the aquatic ecosystem (Hutchinson and Collins, 1978). Each pollutant species would have its own particular impact.

Non-point source pollutants, although rarely as concentrated as point source pollutants, could pose as significant a potential impact as many of the direct effluent sources. Since most of the non-point source pollutants are the same types as those identified above in industrial effluents, impacts would probably be similar. Because non-point source pollutants are rarely concentrated, treatment or removal of these pollutants would be both difficult and expensive.

Fishing: Impacts to game fish habitats, and therefore game fishing, would include degradation of physical habitat and water quality during construction. During operations from other recreational uses of aquatic habitats are expected to cause physical habitat disturbance, sedimentation, degradation of water quality, elevation of ambient temperature, and possible reduction of water volumes. Number of anglers per fishing resource area will increase in some areas, and decreased fishing quality (as measured either by fishing success or aesthetic quality of the fishing experience) could result if management activities are not implemented to compensate for increased pressure (Manning, 1979; Adriano, 1980; Dieringer, 1980).

The game fishery would be expected to experience increased fishing pressure from construction workers and support personnel (Dieringer, 1980). Fishing has been identified as one of the most preferred recreational activities by residents of both states (Nevada State Park System, 1977; and Utah Outdoor Recreation Agency, 1978). Due to the limited number of fishable waters in Nevada and Utah, the fishing quality is likely to decrease without additional management. In Nevada, fish hatcheries at Reno (2), Las Vegas (1), Ely (1), and Ruby Marshes (1), are now operating at their limit and public waters are presently stocked to their limit (Dieringer, 1980; Curren, 1980).

Based on the most recent (1977) state population data and numbers of state resident fishing licenses held, it is expected that the increase in population resulting from M-X construction and operation would increase the number of licensed fishermen by 2.8 percent in 1987 and 2.65 percent in 1994. While there is expected to be an increase in the number of people and fishermen as a result of M-X, it is difficult to accurately assess the specific effects on fishing. The range of the effects is based on the disturbance of people on the unit's habitats. However, without an increase in fish stocking rates and in fish habitat resource, fishing success in both states will decrease with the increased population associated with M-X. Regardless of how many fish are stocked in a given water body, there will be a loss of fishing quality due to a loss of the aesthetic quality of the fishing experience with increased numbers of anglers (Manning, 1980).

Comparison among Hydrologic Subunits: Information about game fish abundance, sensitivity to impact and quality of data, by hydrologic subunits, appears in Table 3.1-3 in the form of ranked values. Abundance of game fish per hydrologic subunit was ranked as follows: low = no identified game fish habitats or resources within the hydrologic subunit; intermediate = hydrologic subunits with less than 12 aquatic habitats with Class 3 ranking or better and game fish located in these habitats; and high = hydrologic subunits with more than 12 habitats with a Class 3 ranking or better. The maximum number of Class 3 aquatic habitats in any one hydrologic subunit was approximately 20. Warm and cold-water habitats were not differentiated. Sensitivity to impact ranking was as follows: low = no identified game fisheries habitats present; intermediate = game fisheries habitats within the hydrologic unit and with contiguous hydrologic units also containing game fish habitats; high = game fisheries habitats identified and no continguous hydrologic subunits contain similar resources.

The following hydrologic subunits were rated high in abundance or sensitivity to impact: Upper Reese River, Big Smokey-north, Huntington, Ruby, Steptoe, Spring and Snake, Railroad-north, Sevier Desert, and Panaca valleys. There are no hydrologic subunits listed as high in abundance and high in sensitivity but the initial seven hydrologic subunits listed above are rated high in abundance and intermediate in sensitivity. Further, the final three hydrologic subunits are ranked intermediate in abundance and high in sensitivity. See Figure 3.1-1, Hydrologic subunits of highest abundance and sensitivity for game fisheries, for the location of these hydrologic subunits in the study area. The stream habitats in these hydrologic subunits are in Table 2.1-2. The siting of M-X project features in these hydrologic subunits would have the potential for the most damage to the game fishing resource.

Indirect effects due to M-X construction and operation could include changes in fishery management policies (e.g., reduced bag limits, decreased number of fish stocked per angler, increased put and take fishing, and increased catch and release fishing) (Dieringer, 1980; Adriano, 1980).

Increased population associated with M-X could result in increased law enforcement needs relating to fishing (e.g., increased poaching, disturbance of native fish habitats, and introduction of exotic species). Increased law enforcement activity due to large influxes of construction personnel have already been experienced in Nevada during periods of large operations at Nellis Air Force Base (Dieringer, 1980).

In White Pine County, it is estimated that full Nevada/Utah deployment would result in the need for up to fifteen new enforcement officers. The siting of an operating base in Steptoe Valley, near Ely, would further increase the demand for new enforcement personnel (McLelland, 1980). The illegal taking of fish would be expected to follow a similar trend as has been found in Elko County over the last five years as a result of an upswing in mining activities in that county. Citations processed for violations of wildlife laws in that county have increased 70 percent in the last five years (Greenley, 1980).

The Department of Wildlife in Nevada and the Department of Wildlife Resources in Utah receive federal support for their sport fishing management programs. The Dingell-Johnson Program matches state money on a 3:1 basis for non-consumptive uses (e.g., land acquisition, research). The money cannot be spent on fish production, stocking, or law enforcement. States could acquire a limited amount of land under the Dingell-Johnson Program to set up new sport fisheries. As soon as the fishery becomes established, however, federal money could no longer be used. The money presently allocated by the states for non-consumptive uses would be insufficient to maintain any additional sport fishing resource habitat (Dieringer, 1980; Adriano, 1980).

Examples of Watershed-Specific Impacts on Game Fish: Watersheds that (1) are involved in one or more specific system layouts, and that (2) were ranked high in abundance and sensitivity for the particular resource were used as examples (see Table 2.2-1). These examples indicate specific areas technically suitable for project siting but where impact potential for a particular resource is comparatively high.

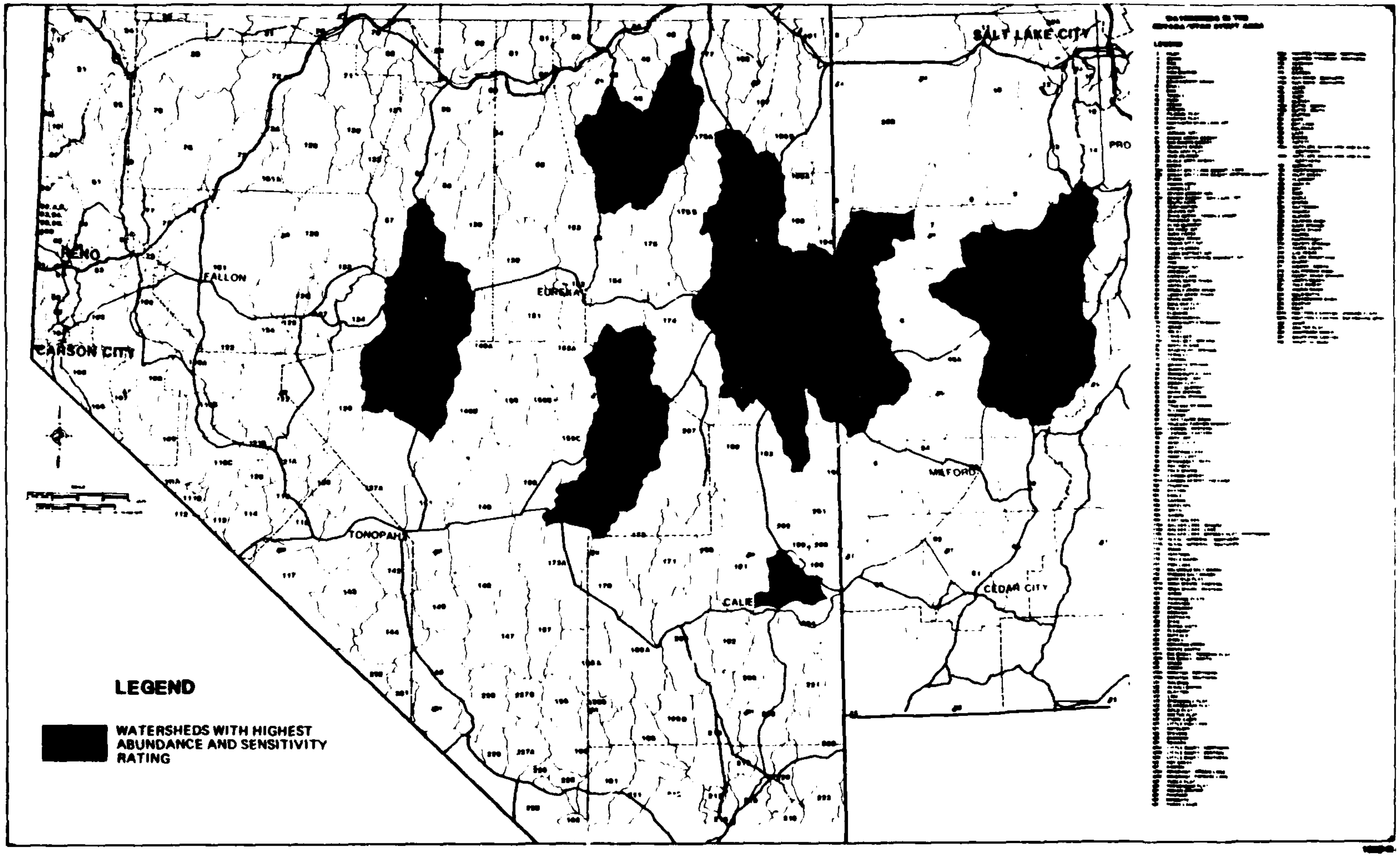

Figure 3.1-1. Abundance and sensitivity to impact for game fish in the Nevada/Utah study area.

Snake Valley provides an example of impacts from cluster deployment. Principal game fish in this hydrologic subunit are trout, and their habitats would be avoided by most project features since trout are confined to the more mountainous regions (Figure 3.1-2). Direct physical impacts would be limited to the few streams that intersect proposed roadways or cluster roads. Water removal for concrete production and dust suppression would not significantly impact cold-water game fish habitats. Indirect impacts from cluster placement would be limited to non-point source pollution resulting from activities, including recreation, of the construction and service populace. No warm-water game fish habitats occur in Snake Valley. Other valleys, however, contain such habitats and would be impacted by cluster deployment where they are closely associated with suitable area. Groundwater-fed warm-water game fish habitats would have a higher probability of impact from water withdrawal because they are more closely tied to valley bottom groundwater resources.

Game fish habitats in Steptoe Valley could be impacted by portions of the DTN (Figure 3.1-3). At the two crossings shown, increased sedimentation would result from construction activities. Once constructed, the DTN would increase the probability of direct pollution from spills and refuse, and until revegetated, the unpaved disturbed areas would provide an extra source of sediment input to downstream segments of Cave and Steptoe creeks. Sedimentation would also occur in Cummin Meadow. Both conditions would adversely impact these habitats and the species found in them. Non-point source pollution would also be expected downstream of all DTN segments. Where the DTN enters areas which are currently not served by an all-weather paved roadway, access to remote habitats would be significantly enhanced. This could increase the recreation value of the habitat, and would probably increase the fishing pressure on the habitat. This would not be the case for the DTN segment between Steptoe and Jakes valleys, as it is planned to parallel an existing roadway.

The presence of a pre-cast protective shelter facility and a deployment construction camp in a hydrologic subunit would cause significant impacts to aquatic habitats in the hydrologic subunit. Snake Valley facility, for example, would require approximately 6,000 acre-feet/year (7.4 x $10 m^3$/year) for its operation (Fugro, 1980). Groundwater withdrawal at this rate would not be expected to have significant impacts on game fish habitats in Snake Valley.

Indirect impacts of the increase in resident human population would be large in Snake Valley. Recreational use of game fish habitat, both for fishing and other uses, would be expected to greatly increase because the construction camp is located near several such habitats in this hydrologic subunit. Since fishing is one of the most favored recreational pastimes of the current population, it is expected that construction workers and other personnel would also participate in this form of recreation. Thus, fishing pressure in the streams on the west side of Snake Valley would be expected to increase substantially. Streams which are closed to fishing to protect rare subspecies of cutthroat trout would be expected to receive more illegal fishing as other streams become less productive. Although it would not be expected from the Snake Valley camp, runoff, including cement washing, from other construction camps and shelter fabrication facilities could pollute downstream aquatic habitats in other hydrologic subunits. Domestic wastes, if not rigorously controlled, could also pollute downstream habitats.

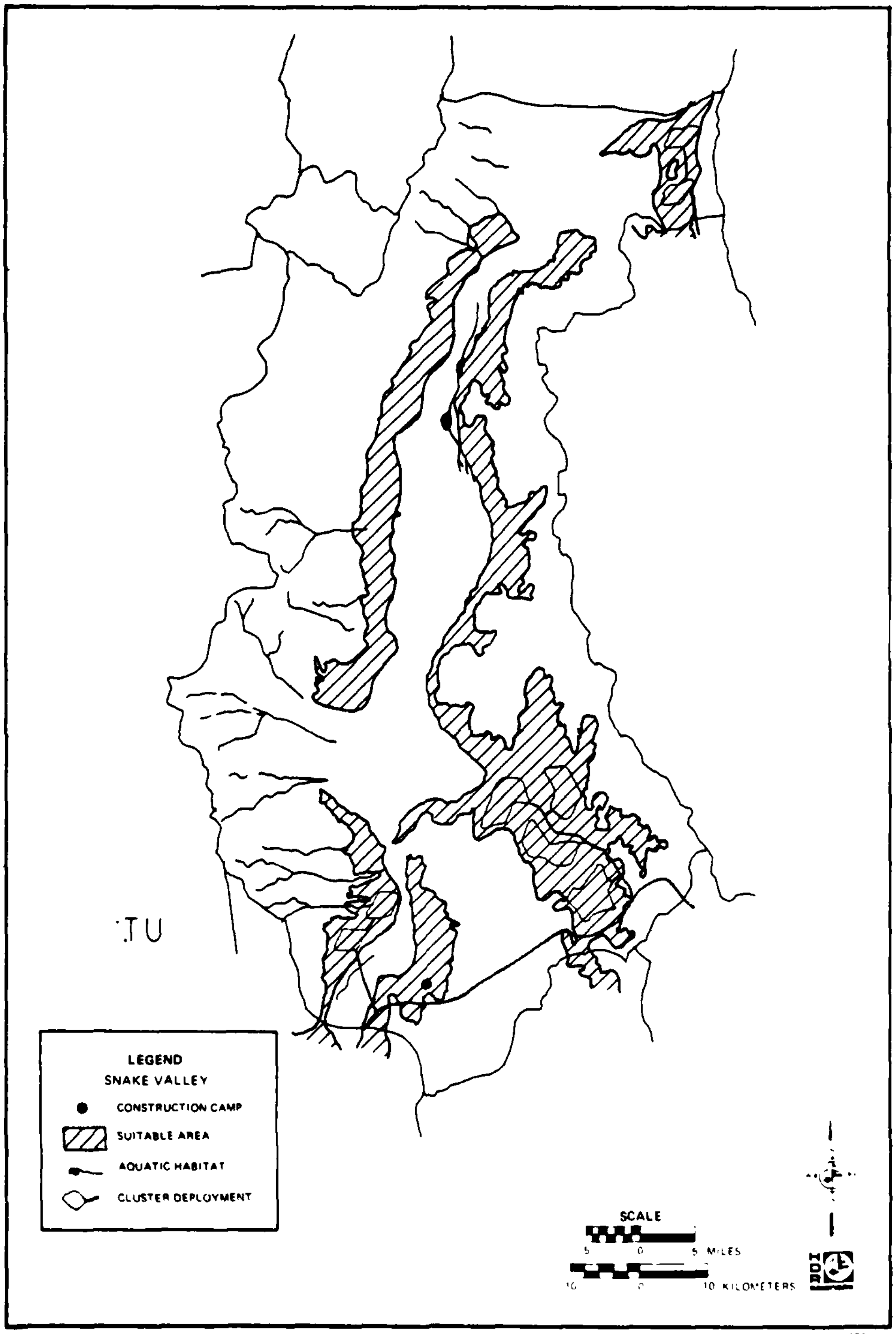

Figure 3.1-2. Aquatic habitats in Snake Valley.

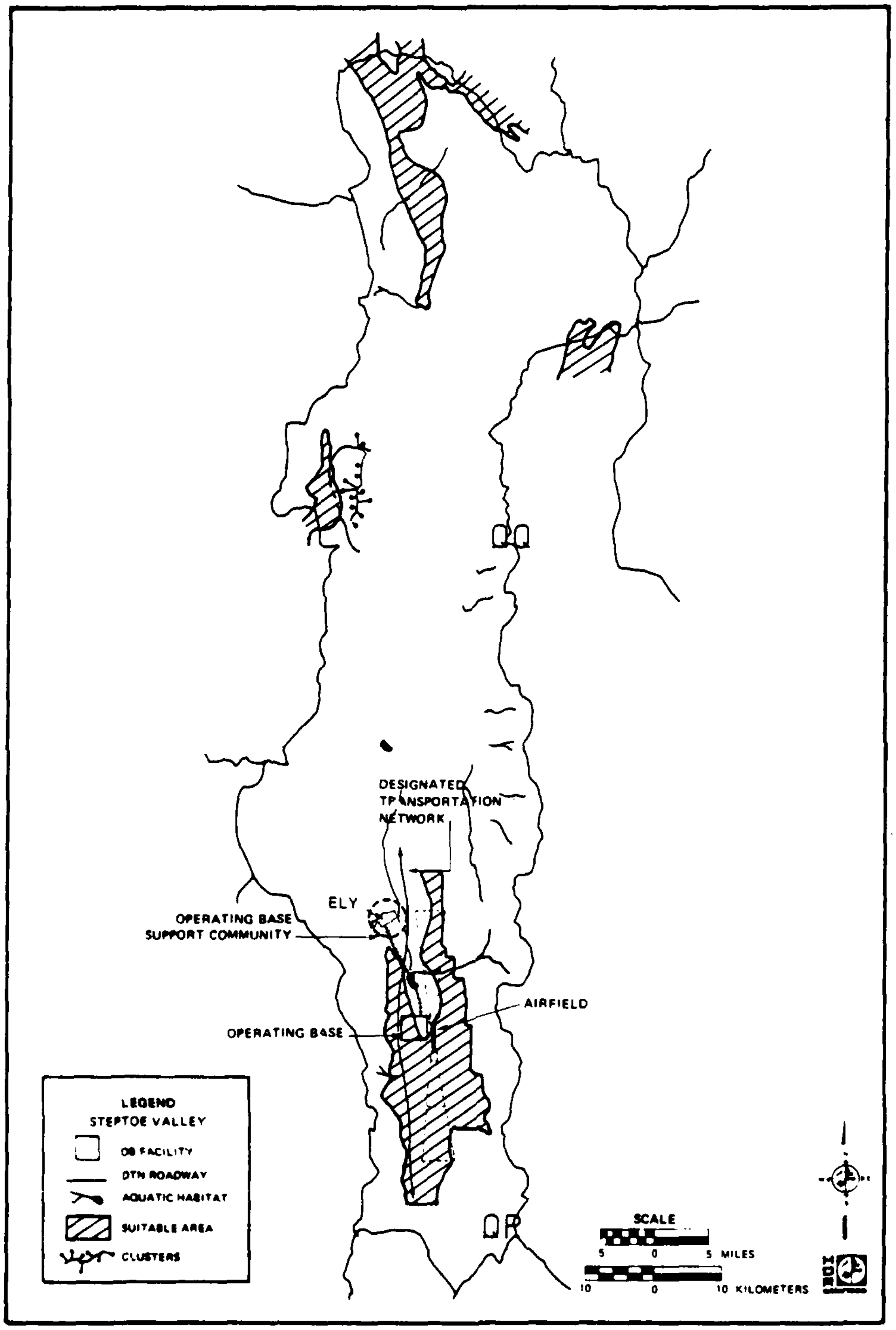

Figure 3.1-3. Aquatic habitats in Steptoe Valley.

Construction and operation of the candidate OB near Ely would have few direct impacts on game fish habitats. Primary impacts would result from urban-type runoff, spills, and soil disturbance. These disturbances could affect cold-water habitats such as Cummin Meadow and Steptoe Creek, downslope of the OB. Sources of the important cold-water habitats found in the surrounding mountains would not be directly affected.

Indirect impacts of OB siting in Steptoe Valley are expected to be much greater than the direct effects. Game fisheries would be impacted by the personnel working at the OB and those providing the required services for these people. Recreational use of game fish habitats, for fishing and other uses, would produce impacts throughout the life of the project, resulting in longer term impacts than those listed for construction camps. Resident fish populations would experience increased fishing pressure. More distant habitats, both in Steptoe and other nearby valleys, would be more heavily impacted as streams nearer the OB become less productive and catch per angler hour declines. Pristine mountain habitats would be impacted by added human contact, both by fisherman and other people searching out recreation areas. The use of ORVs in or adjacent to aquatic habitats would modify or destroy habitat. Native game fish would become more wary of humans. Increased planting of catchable-size fish would be required to maintain fisherman success rates. Pond and reservoir habitats would also receive increased fishing pressure, which would usually result in similar types of displaced population and community structure. All habitats in southern Steptoe Valley would receive increased fishing pressure.

Effects on Protected Species: A more detailed analysis of protected aquatic species resources and potential impacts is presented in the Technical Report on Protected Aquatic Species (ETR-17). The occurrence of protected species in project areas can present important locational constraints to the deployment of the project. Depending upon the level of protection afforded to a particular species, constraints may be placed upon the project to assure the protection of that species. Federally protected species require a Section 7 consultation with the U.S. Fish and Wildlife Service in order to evaluate in detail the potential for impacts to such species and to assure that protection of the species is taken into account. The Air Force has initiated Section 7 consultation with the USFWS for both the Nevada/Utah and Texas/New Mexico study areas. Consultation requires the agency to conduct detailed inventories and to make detailed analyses concerning the potential for impact to listed species or those proposed for inclusion on the threatened and endangered species list. State protected species require similar but less stringent procedures to be followed for maintaining the integrity of the potentially impacted species. Those species that are recommended for protection are also considered as a potential constraint to the project. They may be proposed and listed as either federal or state protected species or both at some point during the progress of project deployment. Depending upon the importance of a protected species to a national or local special interest group, impacts that are suspected to harm that species may be litigated against in local, state, or federal courts. Such litigation procedures could become serious enough to delay or even prevent certain aspects of the project from being completed without alteration and/or mitigation. In some cases, only an act of Congress could waive environmental laws and potential litigation regarding suspected adverse impacts to protected species.

The possible procedures and delays that may occur under Section 7 of the Endangered Species Act are illustrated in the case of the endangered snail darter and the Tellico Dam project. This began with the case of Hill v. T.V.A. (549 F 2d 1064) decided by the 6th Circuit Court of Appeals on January 31, 1977. The Court found that the Tellico Dam project would jeopardize the existence of the snail darter and issued a permanent injunction barring completion of the project even though the dam was in the last stage of a 10-year project and even though the snail darter was not placed on the endangered species list until the dam was almost completed. That decision was affirmed by the Supreme Court (437 U.S. 153).

Congress then amended the Endangered Species Act in 1978 (Pub. L. 95-632) and again in 1979 (Pub. L. 96-159) to establish procedures for obtaining exemptions from Section 7 of the Act. These amendments provide for a review of an exemption application by an Endangered Species Committee. This committee rejected an application to exempt the Tellico Dam from Section 7. The project was thereby halted again until Congress passed HR 4388 approving completion of the dam and giving the project a blanket exemption from all laws that would prohibit its construction. President Carter signed HR 4388 into law on September 25, 1979. The delay on the project extended from 1976 when the case was filed in the Federal District Court until the president approved HR 4388 in 1979.

3.2 TEXAS/NEW MEXICO

Impacts on aquatic habitats and species fall into three categories: direct impacts from construction and siting, direct impacts from operation, and indirect impacts from increased human population (Table 3.2-1). Each of these affects the two types of aquatic habitats in the area differently in both magnitude and form. The river valleys, being geotechnically unsuitable, would not be impacted heavily by construction, nor would there be any habitat lost. This is based on the assumption that no mining of gravel would take place in the rivers. The playa lakes, however, would suffer disturbance and, in some cases, destruction due to interruption of surface flow, as well as to the physical elimination of some of the playas. Water use, however, for construction and operation, should come from the fossil-water Ogallala aquifer, which does not interact with surface water systems in the deployment area. Thus, in contrast to the situation in Nevada/Utah, project groundwater use would leave the surface waters unaffected. Water used during construction would probably be lost to the whole system, but there is the possibility of cleaning and reuse of wastewater during operations. Other possibilities include reinjection of suitably treated water into the Ogallala aquifer or discharge into rivers or playas.

Direct impacts of construction on the river systems derive from alteration of the land surface on adjacent geotechnically suitable uplands. Such impacts could occur in the Canadian River an dsome of its tributaries in Dallam and Hartley counties (Texas) and Union and Quay counties (New Mexico). Several tributaries of the Red and Brazos rivers, such as Palo Duro and Tierra Blanca in Deaf Smith County and the Running Water in Parmer County, could also be affected. Portions of the Pecos River in De Baca County would be near construction activities as well. Runoff from rains would increase and is expected to result in heavier loads of silt than normal due to loss of vegetative cover (Branson et al., 1972). This causes increased sediment load and turbidity in receiving waters and in turn results in burial of benthic habitat which may have been previously unsilted (Cummins and Klug, 1979). Riffle areas in the upper waters of the Pecos and Canadian rivers drainage could be affected, thus altering this habitat for the forms adapted to it.

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Table 3.2-1. Summary of potential impacts on aquatic habitats and species in the Texas/New Mexico study area.

		POTENTIAL IMPACTS	
PROJECT PARAMETER	SECONDARY EFFECTS	AQUATIC HABITATS	AQUATIC SPECIES
Area disturbed	Construction		
	Land used for shelters, DTN.	Loss of small playa lakes too shallow to impede construction; alteration of sheet runoff, water supply to playa lakes.	Loss of habitat for amphibians, invertebrates.
	Loss of vegetation.	Increased erosional silt load added to agricultural runoff, causing increased turbidity, burial of some benthic habitat.	Reduction of primary productivity, loss of food to higher trophic levels.
	Spilled petrochemicals, construction materials, industrial waste.	Introduction of toxic material to riverine systems, where they will eventually disperse, and playa lakes, where they will accumulate.	Effects ranging from behavioral interference to acute lethal effects, depending on pollutant, concentration, and exposure time.
	Operation		
	Revegetation of unused disturbed areas.	Reduced erosional silt load close to pre-project levels; potential restoration of buried stream bottoms.	Increase in hard-bottom species.
Water use		No effects.	No effects.
Vehicle traffic		No effects.	No effects.
People	Sewage	Possible pollution of streams, depending on methods of wastewater treatment and disposal; if nutrient load increases, can expect localized eutrophication.	If eutrophication occurs, population decline with increase in algal growth, oxygen demand.
	Solidwaste	No effects.	No effects.
	Introduction of species.	No effects.	No effects; most warm-water game species introduced already.
	Recreation		
	ORV use.	Disturbance of dry playa lake beds; destruction of stream bottoms at fords, with increased siltation downstream.	Loss of vegetative cover used as food by waterfowl and invertebrates when flooded; population reduction at fords, downstream.
	Fishing	No effect on habitat per se.	Increased fishing pressure on native and introduced game fishes.

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Additional turbidity would also reduce primary productivity, both benthic and water-column, by reducing available light, causing an overall reduction in biomass and a change in species composition in the affected area (Hynes, 1976). Siltation form project-related construction would have significant effects only in those areas currently unfarmed since, in farmed areas, M-X would affect a very small area compared to the area regularly tilled.

In addition to the impact of increased sediment load, pollution from machinery such as spilled petrochemicals, construction materials, and industrial waste from on-site manufacture, could enter the riverine systems. Most petrochemicals used as fuels have varying degrees of toxicity tc life in receiving waters, ranging from interference with chemosensory systems in fishes to lethal toxicity. If sufficiently concentrated, combination of pollutants with increased sediment load could alter the aquatic biota noticeably. Impacts would be site-specific and could be controlled in areas identified in Tier 2 analyses as sensitive through implementation of a variety of spill containment and "clean" construction techniques.

Construction would affect playa lakes in a number of other ways as well. Those lakes near but not directly in the path of construction activities would experience increased sediment load with concomitant pollutants. However, being naturally turbid, they would be less affected by the silt than other pollutants. Because playa lakes do not drain into other water bodies or underlying aquifers, pollutants not naturally degraded remain in playa sediments or become resuspended when the lakes refill with water. This results in concentration of toxic materials over time, with potentially damaging effects.

Construction of roads and shelters also alters surface runoff patterns, affecting water flow into individual playa lakes. These lakes depend entirely on diffuse runoff from rains for water supply. Inlet streams are rare because most of the water flows in sheets (Sublette and Sublette, 1967). Without migitation, construction activities could result in changes in runoff drastic enough to deprive larger lakes of water supply sufficient to support large numbers of migrating and wintering waterfowl. Conversely, this could also cause concentration of water in the larger lakes, with consequent loss of smaller, shallower playas. This potential outcome might actually be preferable, making the larger playas remain filled longer due to addition available water. This depends upon how construction alters runoff patterns.

Although the larger playas are clearly unsuitable for roads, shelters, or base accommodations, the small playas may suffer alteration or destruction during construction activities if they are not deep enough to prevent construction of roads or shelters in or near them. Although comparatively unimportant for wildfowl use, smaller playas do provide breeding grounds for local spadefoot toad populations, which do not use permanent water bodies for reproduction.

Once construction is completed, some of the potential impacts should be greatly decreased. Cessation of soil disturbance should result in reductions of both sediment load and accompanying pollutants. The riverine systems should be able to return to a state similar to that prior to construction. Sediment in runoff to playa lakes not directly altered or destroyed by construction should decrease gradually to preconstruciton levels as revegetation occurs. However, any accumulated nondegradable pollutants would remain. Alteration of runoff patterns would also be permanent, causing changes in water available to given lakes. During operations, runoff of pollutants, such as spilled gasoline and engine oil, would generally be localized to maintenance areas and could be prevented by using standard containment procedures. Runoff of pollutants from roadways should be small compared to that occurring from existing roads in this area. Direct impacts experienced during operation should differ in magnitude, but not type, from construction impacts.

Direct impacts result in alteration or elimination of habitat, which in turn leads to reduction of populations of aquatic species in affected areas. Increased sediment load in streams and rivers resulting from M-X construction activities would not be expected to alter clear-water habitats sufficiently to cause reduction or loss of populations of aquatic species, such as certain minnows and darters and clear-water, gravelbottom invertebrates. Increased sediment load on playa lakes would result in an increase in the rate that the basins refill with sediment, leading to their disappearance. This varies widely from lake to lake, and might be reversed by wind deflation, the same process, that formed the lakes.

Introduced pollutants differ between riverine habitats and playa lakes, and their effects are different as well. In riverine systems, depending on stream flow, density, solubility, and other chemical properties of the pollutants, accumulations differ. In general, concentrations of pollutants decrease with distance from the source and with time. Potential chronic or acute toxic effects on living organisms tends to follow this pattern as well. Conversely, playa lakes, being catchment basins, experience increasing concentrations of pollutants over time with increasing likelihood of toxic effects on the biota. The pollutants would also concentrate up the food chain, potentially threatening reproducing waterfowl which feed on the playa lake invertebrates and plants.

The degree of threat to any given aquatic system depends on the specific pollutants. These are difficult to ascertain at this time, but general statements can be made. (As noted above, riverine systems could be affected in only a few locations while playa lakes could be affected throughout the potential deployment area.) Many organic pollutants, such as oils and pesticides, and heavy metals are slow to degrade and are often toxic in varying concentrations. Collection and treatment could dramatically reduce impacts from these pollutants.

Adverse environmental effects of all of these are expected to increase with time in the playa lakes, but not necessarily in the riverine system, and could be enhanced by M-X activities. In general, impacts from non-point source pollutants are not expected to be significant but could significantly impact specific locations, such as playa lakes (and possibly riverine habitats in the Canadian River drainage), if concentrations are high enough.

Nontoxic pollutants from wastewater discharges (e.g., high nutrient loads which cause nutrient loads, causing increased oxygen demand and potential eutrophication downstream) (Fair, Geyer and Okeen, 1968) and power plant discharges (elevated temperatures and, perhaps, high dissolved salts) are not expected to have significant impacts since wastewater disposal or reuse facilities proposed to support such systems are available locally.

Indirect impacts are expected due to an increase in local human populations. Construction of housing would cause the same type of impact as missile site construction. Because an already existing base is proposed for the operations center, and because several large towns exist at the periphery of the deployment area, indirect effects on aquatic systems due to increased housing would not be great, provided the total work force is distributed widely. In addition, recreational pressure on the surrounding countryside is expected to increase, particularly in the vicinity of the OBs. Use of ORVs in river valleys could add sediment load to the streams, or, if heavy enough, damage stream beds. This would be most likely to occur in the vicinity of the Dalhart OB. Indiscriminate ORV use could also damage upland vegetation, causing erosion and siltation. ORV use in dry or drying playa lake beds could damage emergent aquatic vegetation, destroying cover for birds and small mammals and removing an important source of detritus for the aquatic system. Waterfowl hunting on playa lakes, with the possibility of poaching, is expected to increase. An increase in game fishing, with accompanying pressure to stock exotic species, may also occur. This increases competitive pressure on native species, and may cause drastic population reductions. For example, introduction of exotics and water quality degradation in the Pecos River appears to have eliminated the Pecos gambusia from much of its former habitat. Additional recreational pressures will be greatest during construction and would decrease during the operations phase.

The effects of M-X construction and operation on fishing relate to habitat degradation or loss which would reduce fishery resources and increase fishing pressure. Effects of construction activities on fish habitat include physical habitat disturbance, sedimentation, and degradation of water qualify. The resulting impacts to fish populations are not expected to be significant.

Project-induced population in-migration including indirect population growth would be expected to increase fishing pressure proportionately. Total population increase for full basing in Texas/New Mexico is estimated to reach 13 percent during construction and 5 percent during operations. Unless more fish are stocked, this may result in a decline in angler success for some locations. Increased fishing pressure may require changes in management policies, such as reduced bag limits, shorter seasons, increased put and take fishing, and increased catch and release fishing.

Facilities for all types of fishing--streambank, lake shore, boat or pier--are adequate to meet the expected increased demands of project-related population in-migrations. Wate bodies and rivers expected to receive most of the increased demand include Lake Merideth, the Canadian River, Ute Lake, Conchas Lake and the Pecos River.

The Dingell-Johnson Act levies an 11 percent excise tax on sale of fishing gear and matches state money on a 3:1 basis for habitat acquistion, development, improvement and/or research. As a result of project-related population growth, therefore, fishing may be improved in or near the project area. These monies, however, cannot be used for stocking or law enforcement.

Abundance, sensitivity to impact, and data quality for game fish, all of which are warm-water species, were analyzed and evaluated county by county, using high, intermediate, and low ratings. These were determined in the following fashion.

Abundance of gamefish per county was ranked as low if no game fish habitats or resources were identified, intermediate if suitable habitat was present, and high if game species were reported. Sensitivity to impact was low if no identified game fisheries habitats were present and intermediate if game fisheries habitats were identified in the county. High sensitivity was not used. Data quality is considered high in counties where game fish populations have been reported and low where only limited species information is available. The intermediate category was not used.

Hartley, Moore, Randall, and Oldham counties, Texas, were ranked high in abundance and intermediate in sensitivity (Table 3.2-2). These counties encompass the Canadian River Basin, which, although outside the deployment area, may suffer some indirect impacts. Chaves and Curry counties, New Mexico, are ranked high, due to the presence of aquatic habitats stocked with game fishes, and these habitats are near enough to the deployment area and operating base to be impacted indirectly. De Baca, Guadalupe, Harding, Quay, and Roosevelt counties have gamefish habitats, but these are far removed from the deployment area and are thus ranked low in sensitivity.

Effects of clusters on the two types of aquatic habitat differ. For riverine systems, construction may cause increased siltation carried by runoff. For example, deployment of clusters in Quay County, New Mexico, close to the edge of the Canadian River Valley, may add silt to riffle areas inhabited by state protected fish species. The degree of siltation cannot be predicted without further site specific study.

Since a large portion of the basing area is rangeland, removal of the existing vegetation during construction would greatly increase the potential for erosional inputs of sediments to the aquatic system. However, also as a result of the rangeland vegetation, natural revegetation of the disturbed areas, where topsoil is not completely lost, would be expected to proceed relatively rapidly. Seeds from the surrounding areas would germinate throughout the disturbed areas and result in containment of erodible soils, thereby dramatically reducing the sediment loads of the downstream aquatic systems.

Playa lakes, which are distributed throughout the region, can be affected adversely by cluster deployment and siting. Bailey County, Texas, contains playa lakes of all sizes. These would be expected to experience increased siltation and chemical pollution during construction, as runoff will carry unprotected dirt and spilled substances into the basins. This impact is expected to be insignificant and should be reduced greatly during the operation phase after construction is complete. The same smaller playas may be destroyed by using their basins for construction of protective structures and cluster roads.

Table 3.2-2. Abundance, sensitivity to impact, and data quality for game fishes, Texas/New Mexico High Plains.

STATE/COUNTY	GAME FISHES	
	A	S
Texas		
Bailey	L	L
Castro	L	L
Cochran	L	L
Dallam	L	L
Deaf Smith	I	H
Hartley	H	I
Hockley	H	I
Lamb	H	I
Moore	L	L
Oldham	H	I
Parmer		
Randall		
Sherman		
New Mexico		
Chaves		
Curry		
De Baca		
Guadalupe		
Harding		
Lea		
Quay		
Roosevelt		
Union		

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A = Abundance
S = Sensitivity to impact
Q = Quality of data
H = High; I = Intermediate; L = Low

4.0 FUTURE TRENDS WITHOUT THE M-X PROJECT

4.1 NEVADA/UTAH

Over the next 20 years, aquatic habitats and their resident biota will probably remain in approximately their present conditions if M-X is not deployed. Population projections for the 13-county study area indicate an increase of approximately 55 percent from 1980 to 1994 with about 95 percent of this increase in the major population centers of Reno, Las Vegas, Salt Lake City, and Provo. Thus, population growth is expected to be small in most of the potential deployment area. Agricultural development is also expected to be limited, however pressures to increase utilization of aquatic resources for agriculture will increase proportionately with expanding agricultural development. Current management programs for land use should be adequate to protect most aquatic habitats from degradation since the present water allocation system will restrict increased water use. Recreational use of aquatic habitats, including fishing, will increase in remote areas a considerable distance from these expanding population centers. This has been documented for White Pine County, where increased fishing pressure has resulted from use by Las Vegas residents (McLelland, 1980). Cold water fish hatcheries are currently at production capacity, and no warm water fish hatcheries presently exist. Thus, any substantial increase in fishing pressure will result in decreased angler success unless hatchery capacity and stocking rate are increased.

Mining and energy developments are projected to increase considerably with several large projects already planned for the study area:

White Pine Co., NV	White Pine Power Project
	Reopening of Kennecott mine
Nye Co., NV	Anaconda molybdenum mine
Clark Co., NV	Harry Allen Power Plant
Millard Co., UT	Intermountain Power Project
Beaver Co., UT	Alunite mine
	Pine Grove molybdenum mine

In the immediate vicinity of these mining and energy developments, degradation of aquatic habitats could result from water use, sediment runoff, and increase considerably with several large projects already planned for the study area:

White Pine Co., NV	White Pine Power Project
	Reopening of Kennecott mine
Nye Co., NV	Anaconda molybdenum mine
Clark Co., NV	Harry Allen Power Plant
Millard Co., UT	Intermountain Power Project
Beaver Co., UT	Alunite mine
	Pine Grove molybdenum mine

In the immediate vicinity of these mining and energy developments, degradation of aquatic habitats could result from water use, sediment runoff, and recreational uses by in-migrating people. These effects would be addressed, and possibly mitigated, through the EIS process required for such projects.

Protection of aquatic resources, both the rare and endangered and other aquatic biota, will benefit from the growing public interest in environmental resources and from the increased budgetary prospects for federal and state resource protection and management agencies. Environmental pressures resulting from increased industrial, grazing or agricultural interests should be balanced by increased environmental protection. In conclusion, water use, recreation, and fisheries management, particularly in very localized areas, are expected to increase over the next 20 years within the proposed deployment area.

4.2 TEXAS/NEW MEXICO

In the absence of M-X, aquatic habitats in the Texas/New Mexico High Plains will be undergoing study as potential agricultural water resources. Groundwater overdrafts are expected to make economical extraction of water more difficult over time. The expected maximum lifetime of the Ogallala aquifer is 70 years, but irrigated agriculture is already being abandoned in some areas in the southern part of the study area as water becomes increasingly more expensive to obtain. Thus, the major surface water features are likely to receive increased attention for use as supplementary sources.

The study area contains two major types of aquatic habitat: (1) river valleys and associated springs, and (2) playa lakes. The first category includes the drainages of the Pecos, Canadian, and Red Rivers. Presently, the Pecos River Compact controls water use in Texas (below the study area) and New Mexico, primarily for irrigation, recreation, and livestock watering. Similar compacts govern water use in the Canadian and Red rivers and associated reservoirs. Water use in all three is nearly at capacity. No long-term change in these habitats or their associated biotas is expected in the near future. Projected population increases of 1.5 percent would not be expected to put great pressures on the various warmwater gamefish species. If irrigated farmland acreage gradually is transformed to dryland crop or rangeland, one can expect sediment load to decrease, with improved water quality, and perhaps partial restoration of hard-bottom habitat and associated species populations.

The playa lakes are presently under study as a potential water resource. They are shallow wind-deflation basins dependent on sheet runoff for their water supply. Although most are intermittent, some are permanent. Deepening of the smaller lakes keeps water longer, but at the expense of aquatic habitat area for waterfowl, emergent vegetation, amphibians, and associated intermittent lake invertebrate species. As groundwater becomes increasingly expensive, the playa lakes will be a likely replacement source, in conflict with their use for migrating and overwintering waterfowl. This use conflict will become more apparent as time passes.

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